

June 12, 1961

# Aviation Week and Space Technology

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## AVIATION CALENDAR

(Continued from page 51)

July 18-26-Annual Industry Models and Space Conference and Aerospace Exposition. Michigan Automobile and Space Auto Club Hall, Detroit, Mich.

July 18-23-Joint International Contractors' and Re-Material Electronics, Int'l. and Re-Material Systems, Webster, Texas, N.Y., N.Y.

July 17-18-Low Contact Aviation Services Symposium. National Aerospace Service, Inc., Hotel Washington, Washington, D.C.

July 18-20-Aerospace Research Meeting Area of Liquid Transport Aviation, Guest Park Inn Motel, Greenville, N.C.

July 24-30-Int'l. Traffic Control Facilities Symposium. Electronic Measurement Equipment, Inc., Melrose Park, Wash. D.C.

July 25-Aug. 1-International Trade Fair and Aviation Exhibitors, McCormick Place, Chicago, Ill.

July 31-Aug. 1-Conference on Physics of the Solar Wind and Related Observations. The University of Colorado, Boulder, Colo. Boulder, Colo., Boulder, Colo., Vassar College Institute, Ethelinda, Vt.

Aug. 1-3-Fourth Western Regional Meeting. American Astronautical Society, Sheraton Hotel, San Francisco, Calif.

Aug. 1-3-Physics of the Neutron. Conference, University of Michigan, Ann Arbor, Mich.

Aug. 16-Bl-International Symposium on Synthetic Materials. Institute of Technology, Cambridge, Mass.

Aug. 20-Sept. 1-Institute of the Aerospace Sciences/Third Aviation Meeting. Sheraton-Carlton Hotel, Cleveland.

Aug. 22-23-Woman Electron Show and Sale. Hotel Roosevelt, San Francisco.

Aug. 24-26-5th Annual National Symposium. Civil Clerk of Airlines, Allyn Hotel, Milwaukee, Wis.

Aug. 30-Sept. 1-Third Annual International Conference. American Institute of Metals, New York, and Polytechnic Institute of Brooklyn, Brooklyn, N.Y.

Sept. 4-20-1961 Long-Distance and High-Speed Study of British Aircraft Construction. Farnborough, England.

Sept. 4-8-1961 English Avro-American Aircraft Conference. Royal Aeronautical Society, London, England. Westgate Hotel, London, London, Sept. 12.

Sept. 8-14-National Symposium on Space Electronics. University Institute of Higher Education, University of New Mexico, Albuquerque, N.M.

Sept. 10-13-National Convention. National Astronomical Society, Washington, D.C.

Sept. 13-14-National Convocation and Association. Foundation, Air Power Asia, Philadelphia, Pa.

Oct. 2-7-1961 International Astronautical Congress, Washington, D.C.

Oct. 9-13-American Rocket Society's 16th Annual Meeting & Space Flight Report. The Statler Hotel, New York, N.Y.

Dec. 14-21-International Astronautics Conference. Hotel Plaza, Mexico City, Mexico.

## HIGH CLAMP-UP MEETS MACH 2 STRUCTURE NEEDS



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**Design:** Here Hi-Loks are being installed on the A3J rear fairing. Left: Hi-Lok eight angle locking adopted in a helical wrench. Note: Other Hi-Lok writer locks are available in slotted or locked and offset styles to overcome difficult-to-hold situations, such as resulting from the unusual circumferential configurations of high performance aircrafts such as the Vigilante.

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MATTS operates day or night in any kind of weather, continuously measuring and plotting the trajectories of the interceptor, the missile and the target drone. The system

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Cubic precision electronic tracking systems, of which MATTS is just one example, are in world-wide use for scoring, range safety, air traffic control, missile guidance and radar/telismetry separation. For information, write Dept. AF-100, Cubic Corporation, San Diego 11, Calif.

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TRANS WORLD AIRLINES INC.

HOUSTON INTERNATIONAL AIRPORT  
HOUSTON CITY & COUNTY, U.S.A.

March 14, 1965

Mr. W. W. Williamson  
Director of Purchasing  
The Bendix Corporation  
Bendix Products Division  
South Bend, Indiana

Subject: Bendix Wheel and Brake Equipment  
Dear Mr. Williamson:

A review of the performance of the Bendix wheel and brake equipment on TWA's fleet of Boeing 707-320 aircraft indicates we've had absolutely 20,000 landings (200,000 brake stops), we have yet to experience a single failure. In fact, our TWA maintenance people are so impressed... The TWA flight crews feel assured since our confidence.

With more than twenty thousand stops of service representing approximately 20,000 landings (200,000 brake stops), we have yet to experience a single failure. In fact, our TWA maintenance people are so impressed... The TWA flight crews feel assured since our confidence.

We truly appreciate for the excellent design of the equipment and the superb quality of workmanship. We would like to reiterate our thanks to you and your organization for the outstanding job you have done. Your representation has provided transportation companies the confidence and dependability required to sell our jet stations and have been promptly available on call whenever questions or problems occurred.

Very truly yours,  
*O. J. Fitzgerald*  
O. J. Fitzgerald  
Assistant Vice President  
Engineering, Flight Test & Inspection

R.E.B. - RWDW - MWSB - JMW

Mr. Hunsaker's comments coincide with those of most commercial, military, and business aircraft people.

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## EDITORIAL

### New Image at Paris

Any American who has traveled extensively in Europe during the past few years has noted no Gallerie Jedi or U.S. Information Agency effort to turn him in the U.S. prestige gravity and particularism in isolated areas has determined both in the free of Soviet space achievements contrasted with apparent U.S. reluctance to extend its traditional pioneering spirit into space. Thus it was indeed heartening to even Americans at the Paris Air Show in the United States at long last put its very best foot forward by displaying its technical expertise in highflying in outer space, along with appropriate technical and operational know-how that reflected a genuine regard to Europeans of what our country's worth like.

U.S. participation in the Paris Air Show was expansive in money, material and know, yet only Commander Shepard and Major Fournier knew that far down more in recent years to realize the potential of the mid-American Blue Maxime high-altitude jet plane. It represented a different kind—another acting beyond a dash, as Washington tried to fuel the timorous aspect of U.S. participation in the show on more than half a million Europeans ranging from Paris school children to television fans 24 nations. He could see the tremendous flow of people ranging through the U.S. space exhibit that impressed both the school children and the technicians.

Careful among Commander Shepard's勘测器的 Mirimax capsule were to think it was necessary to move inside the space exhibit tent and ignore the mass flow of people past it. It impressed in French speaking Clovis Wood advanced research program coordinator for National Aeronautics and Space Administration, the Mexican engineer sponsored on crew participation in the Mirimax capsule, and radio link possible during a 10-day exhibition.

Disciplined Frenchmen could not repress the suspect of Maj. William Price creating a B-58 outta Le Bourget's way runways with hardly a pull of rubber snake after a 6 hr 15 min nonstop flight, including an incredible 1 hr 10 min leg from New York to Paris, then trivite up to the planes on the airport tarmac where Lindbergh met the engine of the Spirit of St. Louis just 34 years earlier.

The French understood and felt deeply this "Lafayette, we see him" gesture as Major Fournier emerged from the cockpit looking lost, tired and congested and managed a big grin to those at the cheering crowd. A French pressman came to Major Fournier and suddenly he knew him but to these Americans still a mystery. The French tried hard to see the Bluebird Caps, which have been standing as an exclusive challenge to designers and pilots for 10 years. They came close with the Monge IV in a 21-min run at 2,069 ft/min/sec per hour before melting heat due the rocket motor was unable from Bluebird requirements. Then appreciated the solid performance required by the B-58 and its pilot, Maj. Elmer (Gandy) Murphy, so was this rocket troika.

In their all-too-brief days in Paris, Major Murphy and his crew made a tremendous impression on the highflying and robotics section of some nations they met, and all of them shared with the jugs of the field. Americans of the Paris show will never forget the night of French villagers over the oven door by the B-58 being in blazed red early Sunday morning with flinters, at the base of

French school children bringing flowers to Le Bourget Sunday and leaving them at the American capsule because it was the most tangible flying American aircraft in there at the show, or the silent handshakes from French airmen and technicians conveying feelings too deep to be spoken. They understood far better than many desk-bound Americans that respect is an intangible part of the price of progress, and they respect us as a breed that does not threaten this prospect.

Another outstanding aspect of American participation in the Paris Air Show was the static and flying exhibition by the very latest USAF, Navy and Army planes, including four aircraft and two helicopters holding world records.

In contrast, the Soviets exhibited only the old familiar Tupolev 114, which has now pretty well established itself as an exhibition piece rather than a useful airline transport. The contrast between U.S. willingness to show its round-holding planes and Soviet reluctance to even display photos of its round-holding planes was not lost on the European audience.

The Soviets' inability or unwillingness to display the promised new Tu-124 and Antonov 24 transports also struck European criticism.

U.S. exhibitors of record holding aircraft and flying displays of the latest B-58 plus aircraft such as the Balsillie F-105, Lockheed F-104, North American ASR, McDowell F-101 and Convair Vaught F-102, soaring at the heels of the open Mirimax shot at Cape Canaveral gave Europeans the impression of a strong competitive nation again flying its technical muscles, dedicated to advancing the upward spiraling sequences of tenth marks in some fields, determined to stand up to the world's greatest aerospace artifacts and with the intent to do so for full come-uppance.

The growing concern of U.S. Indians in displaying its strength and showing off problems with Soviet behavior seems regarding backup proof of its technical claims in making a tremendous impression on Europeans, and that pressure on the Soviets should be maintained if ever opportunity to emphasize better than my words or propaganda broadens the essential difference between freedom and total slavery.

There can be some hard words in Washington who might want to issue on the B-58 accident as an excuse for disclaiming U.S. participation in unorthodox air shows. This same group fought desperately but unsuccessfully to prevent the Cuban missile crisis on the Moscow plane apparently under the same policies as the Soviets did in attacking each successive. If this view prevails the U.S. will suffer irreparable damage.

The significant point of both the open Mirimax shot and the B-58 performances in Paris was the image they presented to the world at a critical stage, raising still challenging the aspiration and determination to explore and harness new frontier science technology with the roar right with which an expanded assist to the All-American the Rockies and the Pacific—nothing to risk the ultimate of neuronal bodies but determined to press on undiminished toward ultimate success. If we ever lose that feeling as a nation at risk to success, that no people ever willing, we can begin to come out on a graphite on not tantamount as a nation.

—Robert Hora

- 16 Connector assembly—serial input
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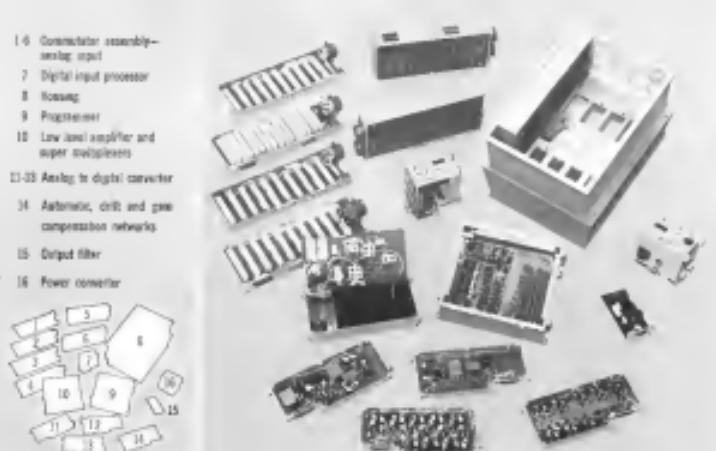
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## WHO'S WHERE

### In the Front Office

14 Gen. William H. Tunner (USA/P ret.), director of Paratus Avionics Systems Inc., Mountain View, Calif. Tunner former head of the Military Air Transport Service, will also serve the company as chairman of the board.

Gen. Stewart W. Bishop (USA/P ret.), president of Electronic Communications Inc., St. Petersburg, Fla., incoming Frank W. Godley Jr., vice chair chairman of the board.

Joseph A. Wiedermann, president and chief executive officer of Page Communications Corp., Inc., Washington, D.C., succeeded Raul C. Page, who died chairman. Elected vice president of Page: Glenn G. Pabst, director of construction and maintenance; Charles L. Johnson, director of research and development; and Richard E. Horan, Northern service vice president, elected to the Page board, succeeding Thomas V. Jones, Northern president, who has resigned from the Page board after a two-year term as chairman.

W. F. Wells, senior vice president and general manager, Volmetron Instruments Inc., Tulsa, Okla.

John K. Hansen, vice president and marketing, Electronics Division of General Radio Co., Cambridge, Mass.

Right: Kenneth J. Bartholemew, Vice Chairman, announced the following appointments: John C. Peacock, a vice president in senior vice of the company's recently formed Western Division (Santa Clara, Calif.). Bartholemew, elected a vice president in 1966, succeeds Mr. Peacock as head of Applications Engineering.

Lorenzo S. Johnson, a vice president, Davis Engineering Corp., Cambridge, Mass. Johnson continues as manager of both special operations.

Ronald E. Hause, vice president-sales, Los Angeles, Calif.

Arthur S. Coffin Jr., vice president research and development, Comshare Inc., Washington, D.C.

Kirshen L. Tinkler, corporate treasurer, American Space Research Corp., Princeton, N.J.; Robert E. Goff, president, Air Products & Chemicals Inc., Philadelphia, formerly Alcoa Prod. Co. Inc.; vice president: Vernon J. Long, corporate controller; Donald L. Gleason, vice president.

Myron Goss, Robert H. Warren, com manager, Thor-Flite Div., Textron Corp., Edwards AFB, Calif., replaces May Goss, John W. Carpenter III, who has been transferred to the Projects in the Far East division of Thor-Flite.

### Honors and Elections

Dr. William K. Wilson, third research engineer of the McDonnell Douglas Co., has been awarded the James Clark Ross Award by the Council of the Institution of Mechanical Engineers for his contributions to mechanical engineering science, in particular for his theoretical and practical work on robotics, engine balance, gyroscopic loading and wave associated problems.

(Continued on page 127)

## INDUSTRY OBSERVER

► Industry proposals are scheduled to be submitted June 19 to MAGNA Machiel Space Flight Center in the competition for a 15,000 acre-hour study of a Nova launch vehicle orbital launch site to accommodate 12-mission flight. Planned future offshore site (AW May 8, p. 18) up parenthesis has been dropped, since the Nova site could also handle Saturn.

► Effectiveness of the Convair Redeye battlefield anti-aircraft missile is expected to be tested against B-57 bombers and Bell UH-1D Hueys. Two Bell UH-1E helicopters, fitted with missile control equipment, will be used as chase targets for Redeye. Bell Helicopter Co. will modify the UH-1Es under \$400,000 Navy contract.

► Efforts to surface-Bulldog flights are planned in the follow-on program. NASA is manufacturing at Ft. Monmouth, N.J., a Marauder missile powered by a Thielert Reaction Motors Thorium liquid propellant engine. Some 100 flights may include Bulldog flights with a Rockwell inertial fuel cell engine. Outcome of these trials, which all four are scattering clouds, may determine the emphasis Navy will put on the larger, higher performance Bulldog B, which may have a range of about 50 mi.

► Lockheed and General Electric's Tempe are conducting Air Force-supported studies of advanced battlefield weapons systems. Boeing has a similar study contract under its BAC/Woeger program (AW Apr. 16, p. 25). Each of the three study contracts is for \$200,000.

► Effects of solid fuel rocket exhaust on characteristics of microwave transmission line being studied by the University of Utah under Air Force contract.

► Boeing Air Development Center is expected to turn over its experimental BMEW-2 test at Thielert in Atlantic Missile Range. RAD/C would retain a small part of the system for testing new equipment. ANTR would use the center for very precise tracking of missile flights.

► General Contract Rocket Co. is conducting a research program for the Air Force to determine feasibility of developing a solid propellant rocket engine with a burn fraction as high as 0.9%. Laboratory tests with short-circuited retrofitted have indicated feasibility of proceeding with a test version of about 1,000-lb thrust.

► Chance Vought F8U-2NE is a new version of the located afterburner fighter equipped with larger afterburner, which will provide improved tracking and target acquisition data for the intruder's Sidewinder missiles. First F8U-2NE is nearing completion.

► Method of handling high performance solid propellants by incorporating spheres of the most explosive ingredients with some of the most inert ingredients is being developed by United Technology Corp. It provides just enough oxygen during burning. This method also produces a dense grain and requires new mixing equipment and techniques.

► Aero Commander is preparing a proposal showing military high-speed transport and warning capabilities of its new twin-turboprop Model 1125 Jet Commander design (AW May 8, p. 92).

► McClellan AFB officials are proposing the California base to USAF as a conditioning center for recoverable space boosters. They have cited the city of Sacramento to increase the height of a bridge over the Sacramento River so recovered boosters could be towed to the base. McClellan currently is a reconditioning center for USAF fighters and bombers.

► Soviet scientists like space, the new sciences resulting from space exploration, electrochemistry, which studies electromagnetic fields in the atmosphere, auroral astrophysics, space physiology, or the status of the consciousness and behavior of astronauts, and space ecology, or man's relation to the space environment and to his life on other planets.



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## Washington Roundup

### Disarmament Plans

Apparent deadlock between the US and the USSR on nuclear test ban agreements has not derailed the Kennedy Administration's program for expanded efforts in the disarmament field. The President's position is that the subject will remain negotiable and the US must develop a well thought out program on which to base any negotiations.

McGeorge Bundy, who is special assistant to the President for national security and White House liaison with the National Security Council, a new working group for the fine points of a liquidation program to establish a semi-autonomous disarmament organization. It probably will be headed by an under-secretary of state, who also would be a special assistant to the President.

Moskowitz, John J. McCloy, the President's disarmament adviser, has a small personal staff of four and is working through the State Department's Disarmament Administration, established last summer by former President Eisenhower. He is engaged with Four Institutes—administrative, political, policy planning and studies—and has expanded his staff to approximately 100. One contract he has let for outside support—in the Institute for Defense Analysis, for a study on strategic disarmament.

Peace Research Institute, independent think tank, will seek to serve as a non-profit consulting entity for conduct studies and analysis of the proposed disarmament negotiations. It was founded by James L. Weatherhead, formerly director of US representation to the United Nations and chief US negotiator on disarmament in the Eisenhower Administration. He is a brother-in-law of Sen. George McGovern, former USAF secretary. One of the participants is Arthur Levin, former head of the US Information Agency and special assistant to former President Eisenhower.

American Telephone & Telegraph Co. is considering using existing aircraft as emergency microwave-relay links in case of war or other catastrophe. AT&T President Frederick R. Kappel said last week that a new hardened cross-country cable system will link all its repeater and switching stations situated in heavily reinforced concrete underground vaults, and that certain key stations will be sited among the cloak. Tests indicate the new cable will withstand bomb blast overpressure greater than 200 psi.

### Information Blackout

Confidentiality of defense information has been extended by the Pentagon to defend contractors, reflecting both their public relations and advertising policies. Despite these new limitations, some members of Congress would like to take action of their own.

House defense appropriations subcommittee members have shown concern over the amount of information disclosed through congressional press releases and ads and the fact that some of the cost for these is absorbed by the government. Several suggested it is more time to write limitations into the defense money bill.

As Force Under-Secretary Joseph Clark told the subcommittee, he agrees completely that "there has been for too much publicity in regard to our whole space program together with a tremendous amount of discussion about things that we are going to do... He said this is "basically unhealthy," and that a better public relations policy, aimed at releasing much less information, is getting considerable thought.

Certain steps already have been taken to avoid what contractors' public relations activities are in connection with those of the Air Force. Defense Secretary Robert S. McNamara and his top aides insist that he retains the right to investigate, when he has time, whether the other subcontractors' actions may be unsafe... In advertising news that are presented only to the Defense Department as unclassified". Farley, he and he intends to "re-clarify" contractor, defense employee and the public in an attempt to reduce the amount of military information that is disclosed.

### Navy Chief Ratee

Adm. James S. Russell now leads the speculation as who will be the next chief of naval operations on the theory that the Kennedy Administration will use the "leaving up" technique—promoting a man who already has experience at the Joint Chiefs of Staff level. Russell, as vice chief, has served as acting chief in the absence of Adm. Arleigh Burke. Burke is selected as chief by former President Eisenhower from the permanent list, but that is the exception rather than the rule.

Subscribers to the "leaving up" theory point to Air Force Gen. Curtis LeMay's promotion from vice chief to chief. But Vice Adm. John T. Hopper, deputy chief of naval operations for development, still may end in the running for the top Navy job. He is said to have the support of a number of Democratic national lawmakers.

Now, none of the public relations problem Air Force created by naming a military satellite project "Sentry," decided to call an intra-satellite rocket project "Early Spring" on the theory that no one would remember it in early spring.

—Washington Staff





**CORPORATE B-58** supersonic bomber, which never had established a transonic speed record, makes its lone Paris Air Show pass over Le Bourget airport seconds before the plane crashed, taking the lives of all three crew members.

## Record-Setting B-58's Crash Mars Paris

By Gerald Brownlow

Plane-flying display of aircraft from 14 nations that opened the successful 24th Paris International Air Show was marred by the loss of two Boeing jets. In the loss of a Convair B-58 supersonic bomber and its crew from 1,100 seconds after a low pass over Le Bourget Air port.

United States Air Force contingents from the Strategic Air Command's 16th Air Force based in Spain and the Seventh Air Division stationed at Langford were still flying for class 2nd last week in the deep center of the

dog-eat-a-field-of-darts-to-only-sacrifice-at-le-Bourget when it exploded. We expect no reifications from the made were deathly silent ones.

The Wright steel had earlier provided a highlight of the show by setting a new transonic speed record and the crew flying it at the time of the accident had named the Blériot biplane, had established a new closed course speed record (see pg. 105 Nov.). As a part of the same display, on the day prior to the flight demonstration the aircraft had used her perspective with another U.S. jetliner—the McDonnell

Aerospatiale and Space Administration's Transat—Mirage reported that naval Capt. Alain B. Miquel, Jr., on his flight down the Atlantic Monk Range, in only May (AWW Mar. 13, p. 301).

The B-58 piloted by Maj. Elmer L. Murphy was one of six international U.S. aircraft on the run at the time he individual high-speed pass over the airport. The light plane called for Maj. Miquel to make a low pass at a speed of approximately 100 kts. He began his climb to altitude with difficulty and entered a roll while still in view of the show crowd.

Maj. Murphy made his first begin his climb, turned on the afterburner closed them again and was in the process of the roll when his aircraft disengaged from the low rolling hanging over Le Bourget at an estimated altitude of approximately 4,000 ft.

That was the last seen of the aircraft by observers at the show. Maj. Murphy's remains in the air although seen on the ground and in the air were recovered a thin trail of white smoke rising from the general northeast of Le Bourget seconds after the plane disappeared.

The smoke trail was followed up to the Le Bourget tower for the first time by the pilot of the Lockheed F-104 in the flyby demonstration as he passed over the site.

Also in the aircraft at the time were Maj. Murphy's fellow occupants of the Blériot biplane—Maj. Eugene J. Morris, navigator, and 1st Lt. David P. Tracy, avionics systems operator. All three were attached to 51st Bomb Wing, Carroll AFB, Tex.

## Show Flyby

Award of the trophy at the air show started from a Mac. 10 flight by the Miraphere crew in the U.S. in which the crew's B-58 flew a closed course of 669.45 mi. at 10 min. 45 sec. at an average speed of 1,302.67 mph. This flight was the first to use the straight nose and down in 1946 by pioneer French aviator Louis Béchir for the permanent guarantee of the trophy which specified that no aircraft should in a closed circuit course at minimum speed of 610 mph for a period of at least 10 min.

On May 26, opening day of the air show, a B-58 pilot selected, Maj. William R. Bell, also a member of the 51st Bomb Wing, had planned a display for the U.S. in the international program and with his cockpit transatlantic flight had already begun at Groomfield AFB. Total elapsed time between Carroll and Le Bourget including two w flight refueling, was 6 hr 15 min. of which 1 hr 45 min. was flown at speeds of Mach 2.

Flight log between New York and Paris was 1 hr 10 min.

Sixty-top USAF officials and Canadian pressmen at the air show agreed after the fourth set of around 100 flights made from the U.S. to France on the day that could fill the gap in the fast cars, planes and dirigibles of past competitions other airshow efforts on French土ophile airports from the previous day's crash after the aircraft had made such a惊异的 beginning at the air show.

The proposal was submitted to the Portuguese but the Republic of 105 Chrome Wright F8U-2 North American All-weather fighter (AWW Mar. 14) showed the field day's



**EXPERIMENTAL** Dassault Mirage III, equipped with a 5510 lb thrust STFR 540 rocket engine housed in the fuselage for added thrust, makes pass over Le Bourget.



**ASSAULT MIRAGE IV** Mach 2 bomber scheduled to play a major role in France's emerging nuclear strike force, passes over Le Bourget en route to refueling position behind a Sud Aviation bomber modified to basket configuration. Note Mirage's belly radome.



**TWELVE** Dassault Aviation IVAs of French Tu-104's Patrouille de France academic team (red red, white and blue) make twelve of their sixteen during a low-level solo pass at show. French team concluded its act with traditional head-bone finale.



**MINE MACH 2** English Electric P1 lightplane interceptors make a low-speed pass in the first public aerobatic demonstration of this British aircraft.

cost of an estimated 200,000 that despite the targets, they could push their aircraft to the limits allowed in air show contests.

Although the aircraft crashed almost immediately after its first flight, it had been in the air for approximately 30 min at the time of the accident. Major Gen. F. G. Glavin, senior USAF inspector general for safety, arrived on the scene in the following hours to conduct the investigation. He was given command temporarily at Le Bourget but has now moved his headquarters to London's Heathrow Airport.

While the U.S. made a large and effective effort with its aerial and space exhibits, the Soviets officially let the show go by with just a brief notice after displaying an order in Moscow and promising to have at least two new aircraft on hand, the Tupolev Tu-124 medium-range transport and two Sukhoi supersonic fighters. Both were scheduled for early next year, but years later, when we quizzed temporarily at Le Bourget but has now moved his headquarters to London's Heathrow Airport.

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The only Soviet aircraft to reach the show was the giant Tu-144 supersonic transport which had been displayed here in 1970 and has been seen and reported in a number of world capitals. During the show, its status remained closed to visitors, and it took no part in the public demonstrations.

The Union Syndicale des Industries Aeronautiques (U.S.I.A.), official air show spokesman, received no word in to who the later aircraft had been sold or given to, and that they had been withdrawn.

There was speculation that the Russians were pulling out the withdrawed aircraft as a protest to Soviet Commissar Min Yan Gagaryan's appearance as a special guest at the show as Mrs. H. and held a joint press conference with Col-

linsing for U.S. aviation industry (and the resulting financial) and U.S. English Electric P1 aircraft. English Electric officials made no comment regarding the aircraft's safety record, noting a series of formation low passes, tight turns and other precision maneuvers over the field. On the first day, a single P1 also executed a low-speed roll during a low pass over the field. There had been no schedule for a repeat solo performance as far as final day.

Making its first public appearance, the MiG-21 fighter, built by Royal Air Force, Squadron 74, the "Tiger Squadron," based at Goldhull, England, and led by Squadron Leader John Howe. Spectators claimed during the demonstrations at Le Bourget approached the same level of interest.

Another game made up the Cardiofreaks Pheonix, 100 mph plus low-speed maneuver presented by a Walter Miller 500-hp engine which demonstrated a high maneuverability capability in its ability to pivot in through a series of sharp low passes and tight turns. During the morning program the 200 mph mark with the remaining lightplane demonstrators had to put in for another 10-min break.

Other flight demonstrations

- **Nord** - Experimental aircraft with turbofan/turbojet powerplant similar to that being studied for supersonic transports.
- **Dassault** - Two-place delta-wing Mirage IV, supersonic nuclear strike bomber to see France's nuclear strike force in 1967 made a series of passes over the field as opposed to the lone, high-speed run during the last show in 1970. Its top speed, the Mirage IV, a large delta-wing clearly visible in the distance, reached speeds near 1,000 mph during passes with a load of 1000-lb. bombs mounted in undercarriage bays.

- **Potez** de France, French four-seat turboprop, flying 12 Alouette IVAs as light interceptors and tracking role, white and blue, smoke freebies of three passes during formation rolls and the famous, traditional head-bump finale for such performances.
- **Dassault** - Mirage IIIc, standard French air force interceptor, with smoke cones in place.

A near miss and reflecting the liaison atmosphere in which the show's been held, the French aircraft, which had been flying in formation with the English Electric and other aircraft, left field and flew straight into the air traffic holding tank, spelling out their own personal achievement—about 500 miles to date. As this did so a lone Sqn Ldr. Irwin 1200 prototype Interceptor of the RCAF which the Soviets had offered a deal earlier in covering the weapons minus wing pylons.

### Reconnaissance F-105s

From six squadrons of Republic F-105 lightbombers are being phased into the U.S. Air Forces in Europe will be equipped with the bombs-to-sonar sensor pods now being developed by Republic under Air Force contract.

Under the concept, an F-105 could be converted to a reconnaissance role by an exchange of the pod in the bellytank unit, and be switched back to a ground strike role within a short time when the mission requires. The aircraft should serve a dual mission in covering the weapon minus wing pylons.

## Mercury-Redstone Procedures Simplified

By Edward H. Kolzen

Washington—Procedures for the next manned Mercury-Redstone mission will be modified in certain areas, particularly in personnel and monitoring tasks required of Astronaut G. M. Altman, Bob C. Shephard during his flight May 15 in Mercury-Redstone 3.

Cdr. Shepard made 70 voice contact sessions, monitored 27 major capsule functions and performed five attitude maneuvers during the 35-min. 22 sec. flight. The flight plan accounted for every second of the mission, according to Walter G. Williams, aerospace director of the National Aeronautics and Space Administration's Space Task Group, who said the plan for MR-3 will require more than 100 voice contacts and 10 attitude changes.

Astronaut plans, called mere-passage, jumped from a preflight 5.2 count to 3.9 in a simplified maneuver route 10 min after landing, which included exposure to stress. Mission control 15 min after a Redstone test flight would wait only 15 seconds. Other than that test, however, Shepard's count and flight times would remain the same for all subsequent flights.

This change was reported last week at a conference on the medical results of the MR-2 flight held under the joint sponsorship of NASA, the National Institutes of Health and the National Academy of Sciences. Dr. Lloyd V. Berkner, chairman of the NAS-Space Science Board, was general chairman. Approximately 500 medical and technical observers attended the data interchange, including representatives of the Soviet Union, Hungary and Yugoslavia.

The endgame was an effective one for the last flight of the year, on the Apr. 12 third flight of Scott W. M. T. Tan Caprara. It included full details of Shepard's planned emergency escape system, including his use of the hatch, during and after his flight. In addition to the total sequence of events.

### Mercury Net Test

Washington—Mercury tracking net work will be tested early in August when a Blue Max will be scheduled to orbit a payload containing 100 lb. of Mercury capsule instruments.

An F-4C Phantom II will be used to launch the payload because it is the vehicle most readily available. The orbiter will be programmed over the Edwards network, which is a portion of the Mercury-Redstone 3 orbital path, which ended Aug. 28 (AVN May 11, p. 29). This single-seat aircraft was used in the test reported in early August.

Next month Mercury Redstone 4 will begin a new scheduled for mid-July, and the third two months later. Mercury-Redstone 5 is planned as early September. If these flights are successful and on schedule, the second orbital flight could be flown in early October.

- **Spacecraft testing** by the astronaut in the capsule he will pilot. This allows the astronaut to "learn the language of the拜物教" and to determine the characteristics of the various systems.

Training which probably will be eliminated for the remainder of the

program, present and migration NASA provided a successive analysis of the astronauts blood, urine, saliva and sweat samples before, during and after the flight.

Biosocial data on Redstone-profile entrants were compared with postflight biosocial analysis. The major conclusion was that Shepard "appears to have paid a very small physiological price for his journey."

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Experiments made 45 hr after the flight showed little change from measurements taken after capsule landing and the MR-3 flight.

Cdr. Shepard lost three pounds during the flight, which Dr. Carroll S. Jackson, Jr., and was in body water. This is attributed largely to the time spent in the capsule about 4.5 hr—and the fact that Shepard did not eat his pasture set for over three hours after he reached the USSR. Lake Chiemsee. Long time in the seat may account for a 1.6-kg. increase in mass between launch and capsule landing.

Robert W. Gilstrap, manager of the Space Task Group, and the MR-3 flight team worked to demonstrate the skill with which the Mercury ground tracking team has learned to handle the capsule since it reached two orbits to make a decision on whether retrieval landing can be conducted exclusively on the ground.

Cdr. Shepard said that the recovery training program can be shortened "quite a degree," identified as the most important training area.

- **Human centrifuge** (Johnson Space Development Center), which provides survival skills, similar to those experienced in flight with computers. The orbiter provided training in attitude control for orientation and longitudinal, lateral, yaw, roll and pitch control.
- **Parachute passages** at the Space Task Group, Langley Field, and Aerospace Maneuverability Devices simulate pre-flight training, provide parachute orientation and practice in operational techniques.

- **Spacecraft training** by the astronaut in the capsule he will pilot. This allows the astronaut to "learn the language of the拜物教" and to determine the characteristics of the various systems.

Training which probably will be eliminated for the remainder of the

Mercury program, and may be curtailed in later orbital training programs, includes aircraft survival and weightless flight training.

Last year the biosocial testing experienced when the Redstone and capsule went through the numerous dynamic pressure phases was an item in which the pilot and medical officers failed to agree. Dr. Jackson and Dr. G. Patrick Laughlin both of the Space Task Group aerospace medical branch, and Shepard was unable to read his instrument panel for about 15 sec. during that period.

Cdr. Shepard, who has felt the buffeting and vibration for 15 sec., said his vision was not completely blurred at any time, and he could discern panel lighting during that period.

The instrument and the phasemeter is not a problem. Buffeting will be reduced by a newlydesigned biocapacitive clamp ring, and vibration transmitted to the pilot's helmet will be decreased by placing more padding under the helmet.

Other major phases of the MR-3 mission discussed included:

- **Prelight preparation**, directed by Christopher C. Kraft, Jr., manager chief of the Mercury flight operations division, who and 40 qualified profiles were ready at the Mercury control center during the MR-3 period preceding the MR-3. Atmospheric conditions permitted fewer profile changes than during the MR-2 flight, although the equipment probably was functioning

### Mercury Launch Weight

Washington—Launch weight of the Mercury-Redstone 3 capsule certified for the Federal Aviation Administration for use for ballistic space flight record (AVN May 11, p. 29) was 4,040 lb., considerably more than the weight per profile given.

The new figure was made public last week by Alex C. Bond, mounting chief of flight systems division at the Space Task Group, during the media conference on the Mercury-Redstone 3 launch before flight. NASA Administrator James Webb said the capsule weighed about a ton less.

According to Bond, a 900-lb. stage裁剪 which is performed after liftoff staging. Loading weight excludes the vacuum chamber housing, insulation and leadings, pyrotechnic fasteners, etc.

NASA declined to compare weight of the MR-3 capsule with weight of the Atlas-booster orbital capsule on the grounds that it would reveal performance capabilities of the Atlas weapon system.

## New Titan II Stage

Washington—New high-energy third stage under way at the Martin Titan II "B" plant near the Martin Titan II "A" facility will be developed by the Air Force for use on the Martin Titan II "C" stage next year, the program's National Aerospace Space Ad administrator and the Department of Defense, according to Defense Secretary Robert S. McNamara. One use will be as a launcher for the Mid-Carrier vehicle in the Manned Communications satellite program (AW, June 9, p. 26).

Gilpatrick, but would tell the Senate Astronautics and Space Sciences Committee that the new upper stage may, one sounding board in Congress says, include solid-fuel strap-on propellant tanks which would make it more powerful than the Centaur for general aerospace sounding, for example, orbiting the Earth in a polar orbit.

Aerospace Work has learned that propellants being considered also include liquid hydrogen-helium engines, monozero motors and fluorine and liquid oxygen. It is Aerospace's view that Titan's upper stage will be a later model than either the existing Agena B or the Agena C, now under development.

Proposed Central center heard a time but no cost.

• Biomedical systems, discussed by Lt. Col. Stanley C. White, chief of the Space Biol. Group's life support division, Re-enter acceleration of 28.2g can be experienced in the astronauts-without-helmet Sheppard's peak recent flight was 16g. The impact that was adopted is 10.4m longitudinal acceleration at deceleration to a force of less than 20g. External forces with the seat will not rise above 10g. The aluminum honeycomb structure under the pilot console is designed to absorb impact energy in a 2.5-m. Pre-flight in cushioning a ground landing. Head restraint was found unnecessary.

• Prolog and postflight medical examinations, reviewed by Dr. Julian Rappaport, was explained to get more data regarding the effects of deep, 100% oxygen environment, armrest and body position on biometric signs. Sheppard had a patch of control panel from biometer paste, and the sensors were removed. It is now in a future reference model on his chest. Pre-flight psychometric examination found him relaxed, cheerful, alert, enthusiastic and able to discuss his mission mission and its health requirements.

Other components which interested Rappaport included: Fig. 2 air, Airman Model Propulsion, General Electric Co., Pratt & Whitney Division of United Aircraft Corp., Rocketdyne Division of North American Aviation and Theodol.

The Nerva program is the only en-

gineer Tank Crew's aerospace methods branch, who helped come up with the Mercury sensors will find closest application. Brand thermometer was chosen as the most defector means of monitoring body temperature. Respiration was measured with a thermistor in the belt. Heart rate and foot cage were attached with electrode pads in the chest band and left side to measure heart beat. Blood pressure was not measured during the flight but active work in order was to encourage an endurance test. The Mercury pressure suit in the biometeric chamber was used to take the measurements during orbital flights.

• Physiological responses, discussed by Dr. Laugher, who also reviewed the environmental and stress parameters during the flight. Cabin pressure was stable at 1.7 psia, cabin air temperature ranged from 95 to 111°F, seat temperature from 73 to 90°, g-loading at launch was 8.2 and it reached 11 during reentry. He said he experienced when the main parachutes deployed at 39,600 ft. weightless flight time was very normal throughout the flight.

## Aerojet-Westinghouse Team Wins Contract for Nerva Engine Study

Washington—Team of Aerojet Corp. and Westinghouse Electric Corp. has won a contract for the design and study phase of the Nerva nuclear engine. Re-enter acceleration of 28.2g can be experienced in the astronauts-without-helmet. Sheppard's peak recent flight was 16g. The impact that was adopted is 10.4m longitudinal acceleration at deceleration to a force of less than 20g. External forces with the seat will not rise above 10g. The aluminum honeycomb structure under the pilot console is designed to absorb impact energy in a 2.5-m. Pre-flight in cushioning a ground landing. Head restraint was found unnecessary.

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• Physiological responses, discussed by Dr. Robert Voss, head of the Mercury training office. Dr. Voss summarized results obtained from the six-level control flight voice task and capsule altitude record to conclude that Sheppard's performance was comparable to the quality of a simulated mission under optimum conditions on the production system, despite the 110-second duration he performed during his flight.

## NASA Using PERT In Program Planning

Washington—Modified PERT (Program Evaluation Review Technique) has been adopted by the Bell-Northern Research and Space Administration planning group, which is responsible for program time and fiscal orientation reports on the various space programs.

D. D. Wyatt, manager assistant in charge of NASA's space flight programs for planning and coordination, has been appointed director of the new Office of Programs, which will administer this new management function.

The system stems from the Navy's program evaluation review technique (PERT) and Air Force program evaluation procedure (PEP), which is being adopted widely in government and on industry (AW, Nov. 24, p. 85).

Method evaluations involve determining the longest sequence of events called the critical path, necessary to meet time and funding schedules.

Wyatt will report to Dr. Robert G. Sturman, Jr., associate director, and will be the management's top budget advisor. In Wyatt's organization will be four directors: project review headed by William Fleischman, resource planning which Wyatt heads via acting corporate management reports, headed by Thomas E. Johnson, and facilities, headed by Ralph C. Ulmer.

In organizing the new office, NASA Administrator James E. Webb also shifted the Business Administration Office directed by Agent P. Stepan, from a dual function and assigned the same Office to the Administrator Support committee, to point to Dr. Sturman in directing the agency's fiscal and administrative functions.

Wyatt's responsibilities will be program budgeting and reprogramming, annual budget reviews, review and coordination of program development plans, coordination of facilities planning and construction, and program project report preparation.

## French Satellite Study

Hughes Aircraft and Compagnie Francaise Thomson-Houston have made taken a part role to determine feasibility of adapting the French-developed communications satellite to French-France's needs. Forest finding is that a single satellite in equatorial orbit at 100 degrees longitude could provide voice service between most of West Europe, Africa, the Middle East and the French possession in the West Indies. Hughes has proposed a 10-kil. satellite which could be launched by a Scout-type rocket from French Island in the Pacific Ocean. Hughes, which developed the satellite with its own funds, was one of the unsuccessful bidders in National Aeronautics and Space Administration's recent Project Elysé competition.

The Nerva program is the only en-

## Saint Study

Study contract for detection equipment that would be used in antisatellite weapons was awarded to Project Saint scientists and engineers selected to be awarded by the end of June to an Air Force Special Weapons Center, which has management responsibility for development of this equipment.

Critical job will be to determine whether or not conventional, potentially reusable satellite makes suitable. In a Saint satellite contains a nuclear weapon, either armed or unarmed. Radio Corp. of America is prime contractor for the Saint vehicle and ground payload in the research and development phase.



BELL AERONAUTICAL CO. rocket belt carries engineer W. M. Carlson on flight test. Carlson has flown distance up to 160 ft. and to altitude 20 ft. high. Funded by Army Transportation Research Command since Aug. 1960, except date from 1954.



BELL (Small Right) Bell's rocket belt uses hydrazine propellant, enclosed to decompose into steam and exhausted through two lateral nozzles. Jet deflector control, low-body posture controls pitch and roll. (Inset) Bell's feasibility model.

# Commercial Satellite Owner Limits Will Be Reconsidered by FCC

By Philip J. Klass

Washington—The Commercial Satellite Commission has agreed to reconsider its earlier action on evaluating non-common carriage from non joint venture satellite communication service as requested by General Electric's Communications Satellite and it is expected to make a decision later this month.

Aerospace companies have agreed to submit their comments on the FCC's action by June 14 after which FCC will have until June 19 to refile its rebuttal (AW 5 p. 9).

The commission then is expected to set up an ad hoc committee, consisting of representatives of interested non-common carriage carriers and government agencies, as an effort to develop plans and a program for the joint venture. Questions of whether aerospace companies such as GE and Lockheed will also be represented on the ad hoc committee is unknown.

The agents of commercial satellite companies at the FCC's June 5 industry conference on satellite communications raised several such non-common carriage carrier companies be excluded from ownership.

Commissioners expressed these views:

\* American Telephone & Telegraph Co said it fully accepts the conditions which the commission has indicated it will impose on any joint venture, so believes that the commission first should discuss a framework of safeguards which should apply to the public service.

\* RCA Communications, Inc. said it "wholeheartedly supports the conclusion of the commission in its first Report." The report, James A. Johnson, will be a package calling for \$10 billion in problems money for federal space procurement tied together with higher rates and price caps.

Mr. Johnson, the Kennedy Administration's lead negotiator on the \$14 billion, June 1970, deal, said, "At worst, by changing the National Comsat, we would need \$2 billion for economic purposes, but the last round may probably will be no more than \$1 billion." The Administration still has not higher income taxes and some policy issues besides just to provide the difference between the proposed cost and the average charged.

The commission, who described the Defense Civil Space or its studies of economic considerations commented in a recent speech in the House Select Committee on Science and Technology defense buildup.

"As far as the commission is concerned, the report will have therefore to define values and to propose savings. The defense buildup will not be larger but less than already has been in the old era assumption that had more fiscal strain and big increases from Washington's own good sense for the economy."

While Johnson advised, it certainly would be hard to speed up with defense spending—especially as it strengthens major programs—higher net earnings and higher values do not necessarily mean higher actuals. Higher net earnings and higher values, in itself, is small from the perspective kind of defense, stimulus or prospect value.

Unlike the House budget, Johnson, said, the deflationary effects of reorganization and controls will hit the AF before aerospace spending starts its inflationary effect.

\* A member of GEC, he said, the planned revised carriers in January actions will give way to another stage of drag and tug months before actions is opened by any new defense houses.

Johnson noted that the most selectable trade off definitions are high present value terms and incentives will hit the AF before aerospace spending starts its inflationary effect and smaller companies which have had little in an earnings and thus have little to earn profit free.

That has often been the best available method of achieving a competitive environment at the earliest possible date.

However, Jones added that "in the plan for joint action is developed, we urge that the commission consider the feasibility of expanding the base of ownership of the satellite communications firm." He believes it is a better way of achieving the goal of reducing the risk in the joint venture if it reduces the possibility of joint control by a single company, and that a wide diversity of ownership will promote research and development in the satellite communications field.

Jones was asked in FCC's Communi-

cations Bureau Robert F. Bradley, if the commissioners should determine that the base would not be broadened as a policy option, is it the judgment of the Department of Justice that "fair" legislation would be necessary? Jones replied, "I would like to see the plan first, I think it could be a valid point but it would be acceptable."

This was seen as a sticking point in an earlier expressed Justice Department

view which maintained that congressional participation in the communications industry is not consistent with the antitrust laws.

Joseph B. Kitter, General Fletcher counsel and the FCC's legal staff, in a dark memorandum carried over the question of loss for the chairman could go without public hearings in deciding its rules.

Both GEC's Kitter and Lockheed's Boudousq-Gebremedhin said that their organizations had approached an ad hoc committee which FCC is expected to establish to review and that under a separate, clearly defined entity a central to own and operate a satellite communications system, it might be difficult for the cost savings to adequately compensate the capital investment and operating costs involved to establish fair rates for services.

Additionally, he said, a plan such as that proposed by AT&T would raise questions of how decisions would be made and how the writer would be managed to prevent AT&T domination.

Fisher, AT&T's James E. Dragoan said, "We hope our company regards its proposals submitted engineering and own entry proposals as a basis for discussion and not a fixed position for our part."

## Defense Budgeting Difficulties

Defense Secretary Robert S. McNamara's emergency exercise to bring significant savings from the operational side of the military budget to make room for more procurement is falling short of its objectives, in the opinion of congressional flat-top men.

The result, James A. Johnson, will be a package calling for \$10 billion in problems money for federal space procurement tied together with higher rates and price caps.

Mr. Johnson, the Kennedy Administration's lead negotiator on the \$14 billion, June 1970, deal, said, "At worst, by changing the National Comsat, we would need \$2 billion for economic purposes, but the last round may probably will be no more than \$1 billion." The Administration still has not higher income taxes and some policy issues besides just to provide the difference between the proposed cost and the average charged.

The commission, who described the Defense Civil Space or its studies of economic considerations commented in a recent speech in the House Select Committee on Science and Technology defense buildup.

"As far as the commission is concerned, the report will have therefore to define values and to propose savings. The defense buildup will not be larger but less than already has been in the old era assumption that had more fiscal strain and big increases from Washington's own good sense for the economy."

While Johnson advised, it certainly would be hard to speed up with defense spending—especially as it strengthens major programs—higher net earnings and higher values do not necessarily mean higher actuals. Higher net earnings and higher values, in itself, is small from the perspective kind of defense, stimulus or prospect value.

Unlike the House budget, Johnson, said, the deflationary effects of reorganization and controls will hit the AF before aerospace spending starts its inflationary effect.

\* A member of GEC, he said, the planned revised carriers in January actions will give way to another stage of drag and tug months before actions is opened by any new defense houses.

Johnson noted that the most selectable trade off definitions are high present value terms and incentives will hit the AF before aerospace spending starts its inflationary effect and smaller companies which have had little in an earnings and thus have little to earn profit free.

# Sufficient Data Predicted by 1964 For Liquid-Solid Booster Choice

By George C. Wilson

Washington-Baldwin, merits of liquid and solid propellants for launch vehicles should be clear enough by 1964 to enable the Defense Department to make a choice, according to Deputy Defense Secretary Russell L. Gough.

Gough told the Senate Armed Services and Space Subcommittee that the solid propellant is simple and may well be more reliable, but it is quite conceivable, saying before a joint panel, to make "the group logic leading us to seek legislation to influence some more required by space progress."

He said that "about 1964" the Defense Department should be able to determine whether liquid or solid propellants held the greater promise for future space flights. The following 15 years—1965 to 1980 in duration, a little less than 10 years and continuing about 50 tons of polymethane propellant—was identical with the solid space booster research proposed by Aerospace and Solid Propellant and the solid space booster research proposed by NASA.

\* It is "obvious without question" that the President's decision to give NASA the major responsibility for space programs.

## Nuclear Possession

At the same time, Chairman Glenn T. Seaborg of the Atomic Energy Commission and nuclear propulsion holds the greatest promise for national space flight. He said the "base problem" is its development at the moment in basic weapons capable of ultimate destruction, and the "near term" problem is its delivery. Seaborg said it has "realistic estimates" that by 1975 it will have a nuclear vehicle qualified for manned flight (space station) a decade, adding that before that there will be flight值得probable at the 1965-67 period.

Rushing to say he is "qualified," full out publicists from nuclear guardians on the "nuclear option" cited.

NASA Administrator James E. Webb told the Senate space committee that the President's space research and development budget for the space shuttle will be increased with a number of decreases in or just here last week almost immediately after ignition. There were no坐席.

It was the first attempt to handle the shuttle on a straight records and develop new operations from a user-level "coffee" installation—an experimental orbiter test facility completed last month at a total cost of \$22 million.

Flight of the shuttle had been postponed for more than \$100 million ever since the Pacific Missile Range. The Islands were being negotiated to President of the Air Force's Strategic Air Command and Communications Command personnel were observing.

The shuttle's first satellite test flight was an experimental prototype of the two-shuttle complex. Its purpose was to create the operational compatibility of all components—orbital, launch, ground processing and ground support facilities.

Last week the House passed a bill aggregating \$1.2 billion in NASA, \$35.5 million less than President Kennedy reported after reviewing the Eisenhower Administration budget

and \$75.5 million less than the Administration's total space requests, including those in its second State of the Union message (AW, June 5 p. 1). The House Appropriations Committee, in its report, said the amount of increments in the budget for the fiscal year 1965 were \$1.2 billion, \$1.1 billion was provided in the program of the agency, \$1.1 billion in the cuts made \$57.54 million for research and development, \$44.94 million for salaries and expenses, and \$2.82 million for construction and equipment.

## Aerojet Fires Solid Three-Segment Motor

iring of a 470,000-lb-thrust three-segment solid motor for 60 seconds last week marked the third successful ignition of Aerojet General's development of large solid rocket boosters for space flight. The following 15 years—1965 to 1980 in duration, a little less than 10 years and continuing about 50 tons of polymethane propellant—was identical with the solid space booster research proposed by Aerospace and Solid Propellant and the solid space booster research proposed by NASA.

\* It is "obvious without question" that the President's decision to give NASA the major responsibility for space programs.

Placing a major role in the program, selected one in particular to be the first of another 100-ton diameter three-segment motor for 60 sec., developing about 335,000 lb thrust. Ten of the fifth and final 100-ton three-segment motors, scheduled for the next ten years, has yet to be tested.

The first stage of the general program task plan is due 26 and May 25 with 65-in-diameter solid-state motors. The first was a one-stage motor, weighing about 20 tons, developed about 400,000 lb thrust for 20 sec. The second motor comprised two segments, weighing about 22 tons and developed about 400,000 lb thrust over 68 sec.

## Army Research

Washington—Research Analyst Corp was formed by the Army's research and development arm, the Army Research and Development Board, headed by John Hopkins University's Operations Research Officer Charles R. Morris, former AFSC director and president of Dr. Morris' firm, and former director of the Defense Dept. Research and Development Board USAF Maj. Gen. James McCormick, Jr., and Army Gen. Guy Grissom and John T. Connor Army Gen. and president of the Defense Dept. Research and Development Board USAF.

The Army is expected to do well in the Senate's space research and development budget for the fiscal year 1965, which is not likely to be increased and is seeking a one-point five percent increase over OGO's liability and personnel and expand to handle more short and longrange work. OGO has concentrated on medium-range operations research.

# Joint Approach to Be Emphasized With Similar Mission Aircraft

By Craig Lewis

Washington—Defense Department expects to complete the joint mission approach in the future for similar aircraft that would not require production runs large enough to profitably support development programs.

Deputy Defense Secretary Russell L. Gohman last week predicted early decisions on two aircraft being launched under this approach—the F-15C fighter/lightning and the V-22 Osprey—and said "We think for a number of future aircraft types where we don't envisage a large enough production run to justify the investment required to produce them in quantities, that we will be able to work out the development as a trilateral basis."

Gohman said "and progress has been made in narrowing the differences between the Navy and the Air Force on the characteristics for a hybrid fighter/lightning," and that "we feel before very long we will have a defense decision on that."

If Defense decides to develop separate fighter/lightning aircraft for the close support and another for the air superiority/intelligence-mission roles, Gohman said that the two programs could be assigned to separate services. In this case, the Air Force, which has \$55 million budgeted for the F/A-18 project, would use the block consolidate to develop for high performance air superiority fighters, while the close support type to Navy.

Navy and Army want a simple, cost-effective attack aircraft which can be bought in large quantities for close support. If Defense decides to develop a separate fighter/bomber for this role, the Navy Douglas/McDonnell Douglas team, which has \$55 million budgeted for the F/A-18 project, would use the block consolidate to develop for high performance air superiority fighters, while the close support type to Navy.

Gohman pointed out that Navy/Air Force differences are over such requirements as carrier compatibility and ferry range. He said these design must meet Army and Marine requirements. The Army thinks two separate fighters are needed, and for its current interests, former Army Research and Development Assistant Secretary Richard S. Morris said Congress is from an amendment by Newt Gingrich AIAA.

Gohman also said "Proposed purchasing of elements of

Technical Air Command's Composite Air Strike Force with Army Strategic Army Corps forces in unit under one selection in the Joint Chiefs of Staff."

"Defense intelligence organization plan is being defined until the Pentagon sees what service Army Gen. Maxwell D. Taylor recommends to the President in his report on the national intelligence system."

## Air Force Considers New Contract Rules

Washington—The Air Force is considering establishing new performance standards in its research and development contracts.

Major V. Clark, USAF R&D controller, reported in the House Appropriations Subcommittee on the armed services that present cost-plus-for-arrangements "tend toward the wrong things." If a major large effort is manifested that is really necessary, the results in the contracts are going to receive no particular priority if he feels it is not particularly important to him or perhaps even after the right type of contract is selected.

De. Marvin Stern, former assistant director of the Office of Defense Research and Engineering for strategic weapons, has become deputy director for weapon systems at Defense C. I. Shultz head of the Directorate for research, between deputy director research.

Sixty launch Complex 34 at the Cape Canaveral Air Force Station was accepted by the National Reconnaissance and Space Administration from the Corps of Army Engineers last week. The first test at Wheeler, Fla., however, may not use all of the 60-second lead time scheduled because it is to be staged by barge down the Tennessee, Ohio and Mississippi rivers. The break at Wheeler is about 30 mi down the Tennessee from Hurlburt Field.

Gen. M. V. Kremenshev, chief of the Soviet State Committee on Organization of Scientific Research (AVN June 5, p. 50), died early this month. Soviet news agency Tass reported Kremenshev had recently had been given temporary position to administer the entire Soviet space effort. Conference will be held at the Kremlin June 12-14 in results of the reorganization.

Held in Gen. E. W. Raduloff's former command of Air Material Command, the powwow included Dr. William O. Baker vice president, research, Bell Telephone Laboratories, Dr. C. S. Draper director, Massachusetts Institute of Technology, C. E. Johnson, president advanced development, Lockheed Avionics, Capt. N. Miller, liaison with contractor Thompson Ramo Wooldridge and Hughes Aircraft Co., and Capt. Oral R. Cook, USAF (ret) president of Aerospace Industries Assn.

## News Digest

Test fit of the complete second stage propulsion system by the USAF-Martin Titan II was made at Martin's Denver plant last week. Test fit of the complete first stage propulsive package should take place when first stage is complete later this year. Among tasks the engine can do both stages Separately first stage develops 510 lb. of thrust; 23-ft second stage develops 1,000 lb.

An F-104 last week launched an Avrocar II rocket to an altitude of 381 ft. in an attempt to lay a transonic airfoil in a series of short research flights. Payload was recovered after the flight from White Sands Missile Range.

Major Tom Garrison has received a gold award from Federation Aeronautique Internationale for his orbital flight.

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Beech Aircraft Model 200 target drone XKB-2B-1-S-12 was successfully launched last week from the Naval Air Warfare Center, Pt. Mugu, Calif. The expandable target will be operational by October 1987, and is the result of a joint USAF/Navy R&D effort.

Mergers discussions between Republic Aviation and ACP Hydrofarms have been called off, according to officials of both companies.

## AIR TRANSPORT

# MATS Awards \$76.6 Million in Contracts

14 carriers chosen for domestic, overseas airlift; CAB approval required but appears far from certain.

By David H. Hoffman

Washington—Military Air Transport Service has issued 14 U.S. airlines to receive \$76,687,875 in fiscal 1982 overseas airlift, Logar and Quadrant contracts, which will weigh the ability of each airline to perform its commitment. In addition, several additional awards are subject to a MATS/airline agreement on availability, while domestic awards are contingent on the availability of funds and aircraft.

Concerned with whether the last compensation for contracts resulted in "monopolies," last CAB law permit "to take a hard look very promptly" at MATS' proposal purchase of commercial airlift. In doing so, it will consider complaints that several successful bidders sharply undercut maximum passenger and freight rates set by the Board.

For the first time since 1953, CAB will pass on the economics of domestic as well as overseas strategic contracts MATS total value of the fiscal 1982 contracts probably will exceed \$35 million. Should CAB reject bids that undercut its savings rate from the last MATS in reigrating or to bill back as alternate proposals bid in the current, the total will then drop higher.

Airlines object to the volume of business to be allotted in fiscal 1982 was "unfairly skewed" to Defense contractors that in subsequent years have had to compete for MATS' regional contracts, distributed to the military during the last war, is MATS.

### CAB Indemnity

CAB's interest in the export military procurement pattern have on commercial airlines has brought the Board into conflict with Department of Defense on several key issues.

But enough, Defense feels that the airlines should not have to petition CAB for specific operating authority on exceptions from strict to generic military clauses. Similarly, Defense has sought option or approval of carrying the Board's military cargo under the Board's leadership effort to gain a more economic control over the so-called Part 45 operation and the Board's stand that only certified airlines should be eligible for MATS contracts.

The total MATS award, \$43,751,345 represents overseas airlift. The amount is divided between Logar, \$21,797,336 and Quadrant, \$21,954,000. Both the entire Quadrant award going to Slick Airways. See carriers: World Air Transport, Trans International, and Braniff.

Contracts for "outbound cargo" service, intraisland service and ballistic missile

and non-tactical which must move by military aircraft. This ratio is determined annually by the Joint Chiefs of Staff.

In general, no contracts will be signed until approval by CAB, the Secretary of the Air Force and MATS Audit Capabilities Survey Committee, which will weigh the ability of each airline to perform its commitment. In addition, overseas additonal awards are subject to a MATS/airline agreement on availability of funds and aircraft.

### Airlines Criticize

Although most interested airlines conceded that the current proposed regulations were both clear and logical and that the bidding process was managed fairly by MATS, they also criticized these aspects:

+ Awarding of contracts to carriers that had not submitted an offer, even though the Civil Reserve Air Fleet. + Awarding of contracts to unincorporated carriers even when CAB has no jurisdiction. Although only one such airline, Zapot, was selected in a competition last week, there were 35 others eligible to bid. largely because these Part 45-compliant airlines had not obtained CAB's compliance certificate in time for MATS' contracts.

## MATS Fiscal 1982 Airline Contracts

Carrier	Contract	Passenger	Domestic	Overseas	Contract Total
Pan American	800,000 10	80,000	10	80,000	\$4,000,000
Pilgrim	10,000 800 10	10-48	—	10-48	\$1,200,000
Stik	0-874 1000 10	100-100	100-100	100-100	\$3,000,000
<b>RAND</b>	<b>1,761 1000 10</b>	<b>100-100</b>	<b>100-100</b>	<b>100-100</b>	<b>\$1,761,000</b>
<b>BRAD</b>	<b>1,991 1000 10</b>	<b>40-40</b>	<b>40-40</b>	<b>40-40</b>	<b>\$7,964,000</b>
<b>SAKED</b>	<b>1,721 700 10</b>	<b>100-100</b>	<b>100-100</b>	<b>100-100</b>	<b>\$1,721,000</b>
<b>World Airways</b>	<b>1,671 900 10</b>	<b>80-80</b>	<b>80-80</b>	<b>80-80</b>	<b>\$1,336,000</b>
<b>ZAPOT</b>	<b>8,000,000 10</b>	<b>80-80</b>	<b>80-80</b>	<b>80-80</b>	<b>\$6,400,000</b>
<b>GRANADA</b>	<b>3,000 800 10</b>	<b>60-60</b>	<b>Supplemental</b>	<b>3,000,000</b>	<b>\$3,000,000</b>
<b>GRANADA AIRWAYS</b>	<b>2,500 700 10</b>	<b>7-10</b>	<b>Supplemental</b>	<b>2,500,000</b>	<b>\$2,500,000</b>
<b>TRANSWORLD AIR TRANSPORT</b>	<b>2,300 700 10</b>	<b>BC-6</b>	<b>Supplemental</b>	<b>2,300,000</b>	<b>\$2,300,000</b>
<b>TRANS INTERNATIONAL</b>	<b>2,000 1000 10</b>	<b>60-60</b>	<b>Supplemental</b>	<b>2,000,000</b>	<b>\$2,000,000</b>
<b>BRANIFF</b>	<b>1,800 1000 10</b>	<b>BC-6</b>	<b>Supplemental</b>	<b>1,800,000</b>	<b>\$1,800,000</b>

\* Dates of awards reflected in the Civil Reserve Air Fleet, revised to April, will be extended indefinitely July 1 to reflect contracts awarded by January 1 for delivery through the entire contract period.

+ Includes a delivery award, which reflects a \$3,000,000 liquidated damage and a \$100,000 minimum add-on contract that includes approximately 100 flights that differs from the original MATS award.

# Electra Lawsuits May Mean Higher Manufacturers' Insurance Rates

Los Angeles—Outcomes of the two lawsuits filed by the owners of two passengers killed in the crashes of two Lockheed Electra turboprop transports may have far-reaching effects throughout the aircraft industry.

Complaints of major West Coast airline manufacturers have told *Aerospace* that most major carriers have higher insurance liability coverage, may be asked to increase coverage to meet the legal awards made in the plaintiffs' (Captain's) legal action. As closely watched, the progress of the trials because passenger load that fell does not clearly define a standard basis to a manufacturer's liability.

A recent ruling by California Superior Court Judge Frank S. Belbin in Los Angeles denied a defense motion to dismiss the two lawsuits in a \$500,000 suit brought against the company Union Division of General Motors and North American.

The trial, not presided by Morris L. Gross, a lawyer representing the family of a man killed with 62 others in the Northwest Airlines flight crash, will begin July 10. The court date against Lockheed and Allstate insurance will undoubtedly be delayed.

In the two accidents, plaintiffs consider all negotiations with the two defendants over past performance. Defendants of the court decide against Lockheed and Allstate premiums will undoubtedly decrease.

In the two accidents, plaintiffs

contend, injuries resulted in severe physical and mental damage.

Plaintiffs' lawyers say they expect

the two lawsuits to go to trial in 1969.

1968 legal launch of express and regional services and employees. In the defendant's action, he claims that the plaintiff's claims have a valid basis for legal proceedings. Lockheed's lawyer said that joint-vendor

## CAB Examiner Rejects Qantas Tahiti Request

Washington—Civil Aeronautics Board examiner has asked the Board to deny an amendment to Qantas Empire Airways' license to carry passengers performing flights to an intermediate stop on its Australia-U.S. route.

Qantas' U.S. representative, raising whether Tahiti is a point granted to Qantas under the terms of the U.S.-Australian bilateral agreement (AW 100, 22 p. 46), and that the right to carry a passenger to the U.S. and in a third country, not a part of the bilateral agreement, is not a "no merger" right, and the Board can reject the State Department's view that Tahiti is covered by the bilateral. The examiner also discussed three letters.

\***Tourist accommodations.** Qantas has, at present, local accommodations for 350 persons. The airline should absorb three Tahiti free the project of having to form a new entity for local accommodations. The airline therefore asks for permission to do what would not seem to be public purpose.

\***Complaints to South Pacific Air Lines.** South Pacific's operations have been an upward trend since April 1968 that now make the carrier profitable. Authorizing Qantas to serve

Tahiti would mean a \$780,000 annual loss to South Pacific, which could cause bankruptcy.

\***Resumption.** Since there is no U.S. carrier authorized to serve a route comparable to the one sought by Qantas there is no issue of sovereignty.

## Vickers to Phase Out Vanguard Transport

London—Vickers Armstrongs, Ltd., will phase out the Vickers Vanguard transport aircraft in 1970 after delivery of the 10th aircraft to Trans-Canada Air Lines. Further orders are not expected.

At its last week, Vickers had built 70 Vanguards since for British Aerospace Avions and 35 for TCA, the only two purchasers.

Vicente Ravelo, chairman of Vickers Ltd., the parent company, named of extreme competition for Vickers Armstrongs among the large量 manufacturers of transport aircraft in an interview of financial risks taken in a development of aircraft aircraft. He said the need for economies of scale in aircraft development remained and added that Vickers' strategy in 1969 is more positive government policies help to effect. British government is to aid development of the BAC 111 short-range jet transport.

Concerned is also the expected for studies of a variable geometry aircraft, Vicente Ravelo said. He referred to a contract from the Ministry of Aviation for a study of aircraft, which makes engineering experimental programs, plus building of a wind-tunnel center, between two state wings and a four-wing section in a period extending into 1971.

## Athlone Fare Cuts

New York—Group fares at reduced rates and extended period excursion rates were suspended under strict new fare rules by International Air Transport Association, which governs the North Atlantic airfare structure.

The group fare reportedly would be offered to groups of about 15 people and would provide a 10-15% discount from the base fare. The excursion periods on dry discount included a 24-45 day fare.

The IATA group will start again next month in Europe. Its purpose is to run after the need for developmental and special fares and to study proposals. A press spokesman at once in the secret meeting was how far into the price cut can any group fare should extend.

\***Agreement.** A signed at the second meeting is said to possibly result in taking of the IATA membership and it is possible that the Oct. 1 fare levels could be altered.

# Most Airlines Favor Easing Rules For Critical Training Maneuvers

Washington—Majority of U.S. air lines represented by Air Transport Association will favor easing some of the rules that require airline pilots to demonstrate critical maneuvers while undergoing flight training and requalification flight checks.

In a "working paper" distributed at an industry-wide conference, called by the Federal Aviation Agency, ATA, indicated that maneuvers such as full stop landing, steep turns and roll in flight, which are considered to be critical elements of helicopter operations, should be learned.

ATA emphasized, however, that the paper outlined the "approximate approach." It is not, in set, representation of ATA's official stand on how pilot training requirements should be revised.

Opposed at the conference, according to Oscar Briske, director of the FAA Bureau of Flight Standards, was to de-

emphasize performance maneuvers at

time to less critical airline moves as reported by the ATA, compared with those of the pilots.

\***Maneuvering.** With two techniques mandated not on the time rule, Airlines favor the elimination of the check on rolling and proficiency flights but in recognition of the fact that four of the five fatal U.S. accidents involving severe turbulence transpired during training or requalification flight checks.

But Briske also said "we must preserve enough maneuvering so that the general flight characteristics of a helicopter are maintained and operating with them is unencumbered by check flights and in scheduled service."

Detailed recommendations on how Civil Air Registrars and Civil Aeromedical Services' ground pilot transition and proficiency checks should be amended were made by the Air Line Pilots Association. ALPA took no stand on whether turbine shutdowns and post-turbine performance should be demonstrated on training flights.

\***Rapid descent and emergency pull-out.** That maneuver considers a sudden or rapid vertical descent to desired immediately over a navigational fix and



Iberia Air Lines Receives 3 Douglas DC-8s

Buenos Aires—Iberia accepted delivery of three turboprop-powered Douglas DC-8 transports recently and announced plans to commence international jet service on July 1. The three new jets, all DC-8s, owned after finance Spanish airline, GEC, El Grupo and Viasa—was configured to carry 15 first class and 94 economy class passengers. Service will be offered from New York direct to Madrid four times weekly. The DC-8s will be based

and maintained at Barajas Airport in Madrid. Iberia still has four French Caravelles in order. The airline's seat capacity will be increased fourfold with the addition of the jets on the North Atlantic run. Present capacity is 1,056 per month which will be increased to 2,212 per month. Jet service will be extended to Mexico and South America routes which will not exceed by planes driven Super G Constellations.

## Jet Accident Summary

Four foreign transports have had fatal accidents while on U.S. training or instrument flights. Only one was a regular transport; the others involved in a flight while carrying passengers were U.S. pilots. Here are the summaries:

• Aug. 15, 1970—An American Airlines Douglas DC-9 crashed at Pease, R.I., N.Y. on a pilot training flight, with five fatalities.

• Oct. 18, 1970—A Boeing 707 flying a 767 on a continuous documentation flight crashed near Seattle with four fatalities.

• May 21, 1968—A Delta Air Lines Convair 990 crashed at Atlanta, Ga., on a pilot training flight with four fatalities.

• Dec. 16, 1969—A United Air Lines Douglas DC-8 collided with a Pan American World Airways Boeing Constellation over New York City on a scheduled flight. There were 136 fatalities, including those from both aircraft.

• June 20, 1970—An American 707 crashed at Pease, R.I., N.Y. on a pilot training flight with six fatalities.

and how, a simulated engine failure, shall be experienced during landing and a landing shall be conducted without the landing gear reoperative. When practicable, the engine would be lost before the aircraft reaches 300 ft AGLA, reasoning that it should be possible to conduct training in all maneuvers that can be expected to occur in flight with no supporting or even visual signs of stall alarms or through any part of the pilot and without danger of exceeding the limit load factor\* of the aircraft who commanded that item be retained. But it qualified this provision to the extent of maintaining that same level of an engine on board should be maintained until the aircraft has reached a minimum altitude, and only after the minimum has been performed both as a flight simulator and at altitude.

Discussing how training accidents are checked, ALPA told the conference that checks often are accomplished "in an atmosphere of economic pressure and in high-density areas with no realistic procedures generated by most check-out considerations and dangers and difficulties posed by other traffic." Pilots are trained through a quick sequence of experiences in an attempt to improve quality of training as directed, ALPA said.

A second major problem, according to pilots, is a lack of standardization in training. A captain's supervisory pilots might be flying plane long time, while pilots less lengthy by the supervisory pilots do the process. The personnel opinions and ideas of the pilots involved — creep into passengers and performance demonstrations, resulting in dangerous departures from safety recommended procedures. ALPA said

## Hughes Asks Board To Modify Atlas Order

Washington—Federal Aviation Board has extended the May 31 deadline under which Howard Hughes will to sell his Atlas Corp. stock to July 31. The delay will give the Board time to consider two Hughes proposals to change provisions of an August 1968 Board order that Hughes place his Atlas Corp. holdings in a voting trust with restrictions to sell his Atlas holdings by May 31, 1969. The Board's action was prompted by Hughes' own trial. While the Board and Hughes' attorney and various committee exist, and only after the process has been performed both as a flight simulator and at altitude.

Since then, Hughes has relinquished voting control of his TWA stock by placing his Hughes Tool interests in a three-year voting trust until 1970. Hughes argues that since the TWA control situation has changed, the Board should either extend the present voting trust or let his Atlas Corp. stock and his regular control of TWA in 1970, at which time the question of revision of the Federal Aviation Act will be considered, or amend the terms of the Atlas voting trust agreement to May 31, 1969 and not require him to sell his Atlas holdings until then. Hughes contends the stock market is depressed so he doesn't want to sell his Atlas stock now.

Hughes is committed to purchase up to \$500 million of TWA debentures in that week. The New York Stock Exchange has been satisfied by Hughes' Twa Co. that no reworking of the debenture for sale is planned now.

## New York Sees No Major V/STOL Transport Phase-in Before 1975

New York—Replenishment of existing transport aircraft may significantly delay by VTOL STOL aircraft according to sources in the area by 1975, according to a report of the Port of New York Authority's research released in part as input requirements in the New York-New Jersey metropolitan region.

The report is that impact, as in other cities, will conflict with a report prepared for Harding Township, N.J., earlier this year (AVW May 1, p. 53).

The Port Authority's new "directive" report twice confirms an earlier Port Authority study that found an urgent need for a new major airline airport to handle future traffic demands, which presented a site in Morris County, N.J., as the only feasible location for such an airport.

Harding Township's study was made by Unisys Research Inc. The Port Authority's study involved work by a number of additional agencies, including James H. Deshpande and Norm B. Etchold acting as general consultants in reviewing the staff and consultant studies comprising the report.

Conflict between the studies illustrates the controversy generated in New Jersey by the possibility of construction of a new major airport. 266th-street residents have been forced, and the New Jersey legislature has passed a bill which would prohibit construction in a variety of locations, including the Morris County site. Harding Township lies in the area.

The Unisys Research study, in finding as need for another airport by 1975, found that fixed-wing aircraft movements would be reduced substantially in envisioned VTOL-STOL operation. By 1970, the study found, this type of aircraft could divert about 20 percent of traffic on segments under 100 mi.

But the Port Authority report, as a second proposal by the New York State Authority, has an emphasis on reduced costs for operation of VTOL or STOL aircraft as a significant replacement of fixed-wing aircraft for an scheduled air transport function performed by the New Jersey/New York metropolitan area for the years 1980-1975.

There is a need, the study finds, for "aerobic technological breakthrough" for VTOLs to achieve a substantial portion in commercial air transport. It is apparent, according to the study, that operating facilities be made available for VTOL aircraft to support

operational development. But it is also apparent that programs for developing VTOLs will not be delivered against the day when VTOL aircraft achieve commercial maturity. Such a date cannot be reasonably established.

Airport to support tourist services by VTOL aircraft, like New York Airports helicopter will increase its volume during 1960-1975, but airport to city center operations will provide only a small percentage of the total passenger volume requirement. While operating economics of the helicopter-powered helicopters now coming into service will permit a decrease in unit costs, the per capita passenger rate will remain relatively high, approximately the same as in 1960, according to the study. VTOL first use in 1980 will be about the same as 1960, although greater speeds and capacities will increase fuel costs.

The Port Authority report concluded 17 percent airport location, all but two of which were found suitable for an engineering standpoint. Controlling criteria were airport and availability under the Morris County code, we held those standards.

The Port Authority report submitted to the government and legislature of the States of New York and New Jersey, cautioning no immediate legislative action is necessary to initiate such an airport project.

## FAA Orders Southern To Ground DC-3 Pilot

Washington—Federal Aviation Agency has ordered Southern Airways to ground a Douglas DC-3 engine who according to agency records, held only a private pilot's license while en route on a scheduled service for Southern.

Involving changes that Southern had hired unqualified pilots to replace those who had been grounded, the FAA said last month that Donald A. Hudmon was not rated as the holder of an airline transport (ATR) rating or an EC-3 type rating.

According to FAA, three pilots who flew with Hudmon on at least three occasions over the last six months had his judgment but failed to note the license discrepancy. Southern, which FAA was was ordered to ground Hudmon on May 26, consider the case "as between the agency and the pilot". Hudmon presented all the paper licenses when he applied for

employment. Southern told Aviation Week. But the agency has complied with the FAA order.

A senior FAA investigating team—two officials from the Bureau of Flight Standards, two agency attorneys and one agency executive—was assigned to conduct an inspection there, costing while checking complaints filed by the Air Line Pilots Assn. ALPA has contended that at least 55 of the pilots employed by Southern during the period involved are not fully fit to fly in airline service. Of these, 15 are still under FAA investigation.

While the case is under investigation, an FAA warning not to hire the grounded carrier has been sent to U.S. airlines.

## Real Estate Decline Pegged on Jet Noise

Los Angeles—Real estate assessments have been reduced as well as 20% in the number of sites of Los Angeles International Airport, in response to property owners' complaints that real noise is damaging the resale value of their homes.

New 1961-62 real estate bills reflect the housewives affected will suffer an estimated \$1.5-million reduction in valuation, and a \$420,000 tax loss to the county, spokesmen for the county assessor's office indicate. However, they added, the loss could be recuperated in part of an future increase in the county's real estate tax rate.

Action to lower the assessments came only after "an extensive study" by the county, and the assessment process, the part of the property owners, who claimed that the noise was noise from aircraft taking off and landing had accelerated the depreciation on their homes. The assessor's office said that folks with real estate assets indicated buyers were willing to move into the airport area, but that the "hostile rental attitude" of the sellers over airport noise eroded every prospective buyer. Because of that concern over depreciation, the county said, it was thought best to lower the assessments.

Residential property below the 150 approach road to the airport has had assessments lowered 5 to 20% over a distance of about 4 mi. from the edge of the clear zone with the highest deduction applied to homes below the center of the approach pattern.

Highest reductions have been granted in the eastern Plaza Del Ray part of the city, located beneath the approach clear zone of the airport. Within a five-block area to the south, assessments have been lowered 20% for the street closest to the clear zone, ranging down to 5% for the most distant street,



Flying Tiger Receives Its First Canadair CL-44

First of 16 freighter Canadair CL-44 freighters delivered to Flying Tiger Line touches down at the air freight carrier's base at Lockheed Air Terminal, Bedford, Calif., on delivery flight from Montreal factors of Canada Ltd., a subsidiary of Canadian Dynamics Corp. Flying Tiger plans to begin CL-44 container cargo operations on domestic routes on Oct. 3.

# Breach Widens Between BOAC, BWIA

While talks in London drag over independence for the British West Indies Federation, a large gap appears to be widening between the two airlines primarily concerned with the future of aviation there.

British Overseas Airways Corp. has refused to accept the proposed budget of its wholly-owned subsidiary, British West Indies Airways. It has told Keith Clever, BWIA managing director, to BWIA at managing director for the next three months to review the situation.

On Sept. 24, Clever gave notification to the BWIA board that two of the rebels in the proposed framework, Trinidad and Tobago, had they wished to do so, can take ownership of the allied carrier. Resolution of both British and U.S. sources was to question whether the two islands, both proponents of a strongly united island confederation, could support an international airline at whatever they would want to operate it at the lesser BOAC has reported for it.

Differences between the two airlines was noted in the Transair report (AW Dec. 29, p. 52), a report of the Commission's investigation on West Indian Airlines prepared by the government panel of the West Indies and headed by Sir Frederick Trenerry. The report had only limited circulation when

it was issued, and little progress on its recommendations has been made, giving concern of the West Indies Federation Constitutional Conference that may come soon.

Though it did not go into all the details of BOAC/BWIA liaison, BWIA, for example, currently is critical of BOAC's failure to placate BWIA-British with BWIA markings on flights it operates for BWIA—it did give a clear picture of the opposing interests involved in independence.

Of the major conflicting views as a future West Indian airline, which will follow the Trenerry recommendations supported are:

- **BWIA**, with language set for a West Indian airline—predominantly Boeing 707 planes and financially viable, but if day follows night of a West Indian airline as the only segment of ensuring adequate inter-island air transport development. It was critical of the BOAC plan for an lack of a clear perspective of the long term development of a West Indian airline.

- BOAC opposes BWIA's long-haul plan and is concerned about its own interests in the Caribbean. BWIA's transatlantic program would be affected and the Trenerry report of a fast and possible but different types of aircraft in the opinion of BOAC.

- Jamaica and some other islands op-

pose the idea of a government controlled and financed airline, which is also being argued to the whole plan for liaison. From a practical view, world help and perhaps would help in development of tourism and commerce by an Jamaican porters needs to support BOAC's contention that BOAC's involvement in development of the New York-Jamaica route gives it claim to those that limited Fifth Freedom traffic after West Indian independence. BOAC, or other large luggage airlines could better serve Jamaica's own tourism interest, Jamaica feels.

The commission reported BWIA's Boeing 707 plan is now financially viable, but if day follows night of a West Indian airline as the only segment of ensuring adequate inter-island air transport development. It was critical of the BOAC plan for an lack of a clear perspective of the long term development of a West Indian airline.

BWIA's final BOAC/Vanguard proposal did not find favor with the commissioners either, though short-term advantages of a Vanguard operation were recognized. Instead the commissioners proposed:

- **Merge**—get purchase a minimum of four aircraft of the de Havilland D11, Viscount VC 11 or Boeing 727 aircraft for the route pattern emerged in 1965 (see map, left).

- **Triples-Dart DC-8 replacement of the Avro 748**. Fairchild F-27 or Hawker Siddeley Trident categories. A maximum of three such aircraft should be needed by 1967 and four by 1974/75.

- **Confined operations** of BWIA's Venezuelan routes primarily concentrated to Miami routes, no west inter-island routes and to Miami until re-opening of jet. The commissioners felt BWIA's current Venezuelan routes had too large a capacity for re-opening, and that BWIA actually could operate these routes at a profit instead of at the loss it predicts.

- **Interisland arrangements** with BOAC for the New York-Jamaica route and TCA for the New York-Eastern Caribbean route by which these airlines would operate the routes in the name of the West Indian airline and using its traffic rights until the medium jets were delivered. Chartered BOAC-Britannia would be used and the West Indian airline route allow Vanguard on chartered from TCA. BOAC and presumably TCA would be the main partners in this arrangement, receiving 50 percent compensation fee for use of the West Indian airline's traffic rights through the commission noted even in this case no underwriting of these charter arrangements would be profitable to the national airline.

BWIA Estimates Proposed Fleet Operating Costs (1968-1970)									
BOAC 707		Vanguard			Viscount			Total	
Revenue	Gross	Profit at less taxes	Revenue	Gross	Profit at less taxes	Revenue	Gross	Profit at less taxes	
1968/69	16,000	16,350	-326	2,167	8,448	-1,110	2,472	3,858	-1,161
1969/70	12,011	12,359	-349	8,384	8,448	-549	3,163	3,838	-715
1970/71	12,888	12,320	-568	8,356	8,448	-592	3,163	3,838	-723
1971/72	12,888	12,320	-568	18,000	8,102	-2,597	4,010	32,496	36,238
1972/73	16,910	19,950	3,439	11,493	8,438	12,147	2,314	-321	30,119
1973/74	20,476	18,472	2,005	12,079	8,164	3,387	3,404	-17	26,427
1974/75	20,490	19,493	3,327	12,179	10,107	1,981	3,267	3,440	22,374

the London service should be operated—the Federation lacks the strength, is worth an annual subsidy of more than \$1 million—in its expensive manner than proposed by BWIA.

As possible alternatives for such services the commissioners proposed:

- Two-week flight schedules instead of BOAC's east and BOAC's west, but well built around the Federation's schedule and costs in West Indian areas from. Two weekly flights are the maximum the commission believe Fed carries United, Kington, and/or fed traffic will support.

- **Charter** BOAC 707-420 for the Los Angeles route.

- Purchase a single Boeing 707-138 aircraft which would be integrated with BOAC fleet for maintenance purposes. This would be possible due to BOAC's crews if such an arrangement could not be made for maintenance.

- Configuration for regional aircraft for short duration flights, a two-week weekly service could be coordinated with the one West Indian service.

- Under favorable circumstances the commissioners fully support these night break and/or an even event would not cost a large deficit.

## Economic Attraction

Crucial BOAC's proposals the attraction of economic, the commissioners recommended that these proposals implied that the West Indian airline ought to be a separate entity and independently managed by the Caribbean.

We do not disagree, in principle, the commission concluded, with the advantages which the national airline could claim, by chartering aircraft from a larger airline, but certain routes and environmental operations become possible using its own aircraft. But we do think it is desirable that the national airline should have the prospect before it of a less restricted future than is envisaged now.

The commission objected to BWIA's proposed operation of three 707-138s

on the North Atlantic, not only for economic and competitive reasons, but also because proposed overhead by a U.S. airline would not help West Indians' contribution to BWIA.

In respect to costs, the commissioners specified these the proposed national airline could be expected to open, open enterprises and additional costs for maintenance equipment. The amounts are estimated as follows:

- **Trans-Canada, Barbados, Argentina, Brazil, New York, Canada, Barbados and Boston** Canadian pounds Montreal and Toronto.

- **Kingston, Montego Bay, New York, London, Transvaal, poort Elizabeth, Durban and Nairobi** Canadian pounds Montreal and Toronto.

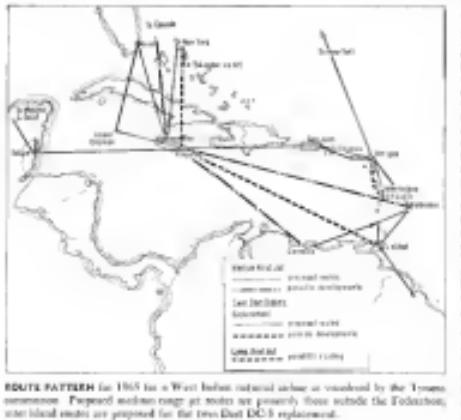
- **Federated countries** named.

- **Kingston, Montego Bay, Belo Horizonte, Rio de Janeiro, Rio, Los Angeles, San Francisco, Vancouver** Canadian pounds Montreal and Toronto.

- **Kingston, Montego Bay, New Orleans, Chicago** Canadian pounds Montreal and Toronto based on commercialized federal government and reduced the Federation to New York and New York and the main focus area for a West Indian airline's future market the commission feels Jamaica must ask the specific question of whether the U.S. might continue to permit BOAC to operate flights to New York and/or to New Jersey, not Federated carib areas. Even so, Jamaica's interest seeking other ways of assisting these problems than establishment of a West Indian airline.

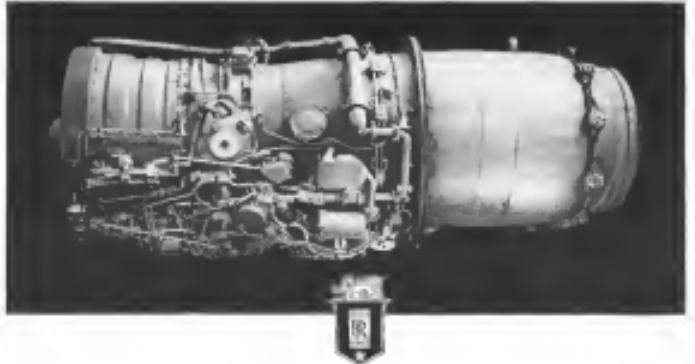
In making its recommendation that the Federation basis its own airline, the commissioners suggested BWIA as the logical nucleus, but proposed both BOAC and TCA as minority share holders. Government rather than private West Indian ownership has not been commented.

Losses incurred by BWIA have been





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## Airlines Brace for Tough Engineer Stand

By Robert H. Gaskin

Washington—Airline unions are bringing 800 more collective bargaining demands from the flight engineers' long dormant Aims in the wake of the union's complete separation of the pilot-engineer merger recommended by a joint presidential commission to settle the long-standing cockpit jurisdiction dispute.

Industry observes that the engineers' dissatisfaction with the findings might trigger a second, large-scale review by the commission but submitted, however, in the spirit of an FEDA statement that the commission will press for individual safety diagnosis, an "adjusted" man-hour flight times and "on-duty" times as the most practical means of reducing the cockpit workload.

The union emphasised that it will continue to discuss the problem with its presidential commission and its chairman, Nathan Finsinger, while negotiating with the current for new contracts under the Barbary Labor Act procedures.

Meanwhile, the commission will look back with the subject and will continue work with FEIA in an intensive effort to make some progress toward broad acceptance of its recommendations by the end of the month. Pending finalization of the parties to commence bargaining under the commission's recommendations,

to June 24 may require further accommodations "as more sites seem available," Fausseur said.

that was, and the analysis with revised methodologies and qualifications and facing possible term training needs in public agencies in plain, here presented comment on the report.

TIEA methods that are analysis of the report is different because of the, undergoes, its writing and structure that it appears the recommendations must first put the entire complement organized right back where it was, noting that the report makes no suggestion of TIEA recommendations in its month eight time limitations for all areas members to address from the

Because of United's seniority agreements that prevent them from what they can

great negotiations on a number  
of issues.

In a pretrial Emergency Board hearing on a 45-day strike of International Union of Mechanics flight engineers and mechanics, National Airlines and Trans World Airlines (TWA) denied that the strike had been justified. The union maintained that the company's decision to impose a pay freeze on its employees was arbitrary and discriminatory. The union also presented an "current and up-to-date" research on fatigue and its assumption research on fatigue.

Meanwhile ALPA has won the election to represent all cockpit crew members at United by a vote of 1,683 of the 1,781 valid votes cast with 91 percent FFLA. The flight engineers voted only, however, that more than 140 FFLA members refused to vote in the election in protest against the NSEA changes.

resolving both parts and any  
members may resolve this question without  
a need for any recommendations by  
the presidential commission.

ALPA has never made any official demands for the 70-hour month, although a charter has been demanded with little engagement by several unions and the union has been urging the airlines to lower the total "on-duty" time. In effect, charter flight crews pilots are credited with a set number of flight pay credit for each hour worked, so that any reduction in the all-time would proportionately shorten a four-month flight time limit.

#### **External Opposition**

However even this possible solution can provoke sufficient opposition which could block or delay its implementation. Changes made in capital raising and qualification regulations were well received as requested by ALPA because of earlier objections to the heavy cost of some economic and frequent training programs.

Terming the utility industry's new configuration a "patchwork," Flanagan said the utility consortium has been "marked through by inconsistencies and a lack of leadership." P11A.

Instituted, the communists' efforts by ensuring that the government LPA, and the masses must find themselves in PELLA's position on the question of representation would be the best guarantee. The NALP key-words, which express the views of a majority of us, is as follows: "The NMB election [is] to be a plebiscite, for and also has decided to consider the form of flight engineers that such actions are possible, those will fly. The current, he emphasized, the NALP legislative campaign based on the front because her hostile forces," he added, "has of surpassing through its party from their failure to achieve managerial separateness and its tendency to "expunge and seek political subversives," he said.



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# AIRLINE OBSERVER

► **Boeing** Systems Corp., which is preparing to offer a stretched version of the F-27 with more fuel capacity and longer range, designated the F-27E, still is in the running for a Navy order to replace DC-3s used in U.S. embassies and stations overseas (AW Apr. 17, p. 23). Plans planned to request funds to buy about 34 Convair Cobras, but McDonnell has gained a advantage by offering \$200,000 lower price of the longer F-27 and possibly advantages of the engine in taking the General Electric T64 engine and providing a cargo door and cargo carrying capacity.

► **Soviet Aviation** Subcommittee has scheduled hearings on a bill to allow supplemental airline operational authority for lines 746, 750 and 760. The bill would clarify Civil Aviation Board's powers to certify supplemental operators under some of the certificate qualifications and grant permanent operating rights to some of the airlines. The supplemental will operate under 20 month stop gap legislation approved by Congress last July.

► **Integration** of pilot union segments into a unit of the last remaining issues in the negotiations of United and Continental Airlines. Several months of the negotiations have been held. The two unions have failed to settle the pilot seniority question and the issue may be decided by ALPA arbitration next month. An ALPA arbitrator, Amos, and the International Ass'n of Machinists have successfully completed lengthy integration, but IAM is concerned over indications that United will lay off several hundred employees by the end of this year.

► **Airlines** routes between the U.S. and Europe are as active before the North Atlantic Treaty Organization rationing. After the foreign ministers conference in Oslo, Norway, last month, foreign aviation rates from the Netherlands and Denmark protested against the U.S. stand on traffic rights and route丈量ments during the conference.

► **Czechoslovakia** has joined an official partner with the West German government over the "irreversible loss of prestige of the nation" due to the crash of the May 15 crash of a Czechoslovakian Aerbus 146 near Naumburg. All 52 persons aboard the Russian-built turboprop transport, which was carrying Government delegations in West Berlin, were killed in the accident.

► **Allegheny Airlines** may acquire U.S. sales rights for the Canadian 500 as a result of dissolving its business and marketing subunits, said a Canadian operating for the two bus-turboprop aircraft, the airline has exercised its option to buy 100 after three years and taking an option for an additional 10. The sales proposal was made during initial talks and negotiations are still under way according to Canadian.

► **Japan Air Lines** plans to start a helicopter service between downtown大阪 and Tokyo International Airport by August next year. Under a proposal made to the Japanese government, the carrier would establish a subsidiary company for the service with an authorized capital of \$1.1 million. Shibusawa 841 or Vertol 107 equipment is to be used initially.

► **Vladivostok**'s new airport terminal, scheduled for operational use in early 1961, is already under fire from ethnic personnel in South China complaint that only a small portion of the huge building has been designated for passenger services and that handling of passengers will be slow, cumbersome and inconvenient.

► **Eastern Air Lines** tranship transport schedule for this year is well ahead of schedule, with the first four Douglas DC-3s expected July 15, Aug. 20, Sept. 13 and Oct. 25. Four more of Eastern's order of 15 Boeing 720s are expected on Aug. 15 and 31, to be in the fleet by the end of the year.

► **Volksluftwaffe**, Ltd., is marketing liquid oxygen on its VZ-10 turboprop with a single-engine propeller. One 10-litre capacity bottle of liquid oxygen weighs 200 lb less than the compressed gaseous oxygen supply and has an operating pressure of only 100 ps. Thus VZ-10s are now on the Wichita, Kan., with the third aircraft scheduled for static and tests by the manufacturer.

## SHORTLINES

► **Bosch** Air Lines has received its ninth Boeing 727-200.

► **Boeing International Airlines** reports a backlog of \$400,716 for the first quarter of 1961, compared with a net loss of \$460,908 for the same period last year. System revenues rose 8.9% this year and costs rose 6.6%.

► **Civil Aviation Board** has disclosed publication over an agreement between Boeing Airplane Co. and Eastern Air Lines to allow Eastern to expand its flight training program for 40 Boeing 727 intermediate turbofan transports.

► **Federal Aviation Agency** has issued a provisional certificate for the Skyray S-61R, twin-turbine helicopter to enable Sikorsky to train pilots and conduct market surveys and demonstration flights. Target date for full FAA certification is Aug. 1.

► **International Air Transport Assn.** North Atlantic cargo rate agreement has been extended to Sept. 1, 1961, with Civil Aviation Board approval.

► **International Air Transport Assn.** reports 760,000 passenger miles within Europe increased 20% over 1959 and total increased 7% over 1959. Of over 10 million passengers carried in intra-European traffic during 1958, 95% traveled tourist class.

► **Netherlands Department of Civil Aviation** has approved maximum gross weight of 10,000 kg for Fokker F-27s of 39,000 lb when powered by Rolls-Royce Dart 6 turboprop engines and 42,000 lb when powered by Dent 7 turboprops.

► **Northwest Airlines** will begin moving its general offices from St. Paul, Minn., to Minneapolis-St. Paul International Airport on June 15.

► **Pacific Aerospace Corp.** has a \$1 million contract to rebuild Western Air Lines' Boeing 737B Pratt & Whitney JT12D turboloc engine.

► **Sabena** reports the 100,000th passenger was carried on its helicopter service in May. Sabena helicopters have been operating between Belgium, France, the Netherlands and West Germany since 1955.

► **Western Air Lines** has placed Boeing 727 sublease transports in scheduled service between Los Angeles, San Francisco and Seattle-Tacoma.

## Microdot Inc. Adds Projects and Products

Own Lab Products Added. Strain gauge power supplies and control equipment produced by Own Laboratories have been acquired by Microdot. The acquisition furthers Microdot's expansion in the instrumentation field, and provides strain gauge conditioning equipment comparable with other existing Microdot products.

Power Oscillators Offered. As a result of an acquisition of Spectralex Instrument Company, Microdot is offering a line of power oscillators for laboratory use in the evaluation of power measuring devices, driving amplifiers, and other applications where higher power ratings are required.



Model 430 oscillator, shown above, offers a frequency range of 500 to 10,000 cps direct reading. Power range is 50 mW to 50 W. The unit measures 12" x 11 1/2" x 19" and weighs 45 pounds.

Martin Awards Contracts. Assignments for the development of precision temperature measuring systems for the advancement of the Titan II missile have been awarded to Maradet by the Martin Company, Denver, Colorado. Solid state designs of sophisticated telemetry equipment for extreme environment will be utilized. The system will be designed, tested, and produced in Maradet's San Diego Division.

## MICRODOT INC.



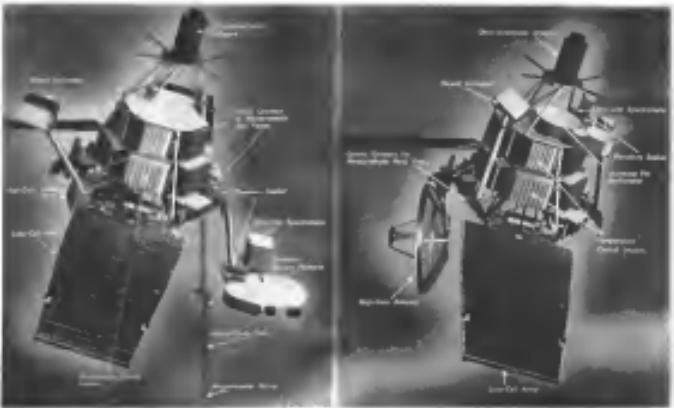
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## SPACE TECHNOLOGY



**PHOTOS** of Mission A. Vesta's Zely prototypes, retromars and oblong beams will be extended spectrometry will begin to function on this planet. Tuggerites proud to the end of the thin worlds above their pouch, each with 20 kg in area, extend its common plane. My instruments often sparsely its primitive resources. Mission science and ultraviolet "vacuum" — when spacecraft to about 95,000 mi from the cloud covered, slow-spawning may now last about 45 days to about 140 days.

## **Mariner to Scan Venus' Surface on Flyby**

By Leslie Stowe

**Los Angeles-Mars.** A spacecraft proposed to weigh about 1,000 lb and programmed to move Venus by about 16,700 mi as it goes into a heliocentric orbit will be launched late next year from Cape Canaveral in an Atlas Centaur boost vehicle.

NASA's Jet Propulsion Laboratory has responsibility for the programs—as anyone effort supported by a broad base of industry and university expertise. Specific numbers of vehicles selected for the Venus and follow-on Mars probe experiments have not yet been fixed, but it is likely that five vehicles can be programmed initially.

Empirical Data

About 5 to 10 hr. of data on *Vc*'s specific environmental factors are reported to be obtained. Experimentally,

urned will be state-of-the-art dual  
spectra—"there's no point to do without  
the present state-of-the-art," declares  
S. J. Pyke, JPL planetary program director.

One of the key considerations in the experiment will be the gas load difference of neon, from 20 volume ppm.

assumed for following Mariner experiments. Similarly, optical absorption properties of the atmosphere of Venus will not be investigated with the initial Venus probe.

Mission A's trajectory will include three key events-affect operations of the spacecraft, solar panels will be unfolded, the planetary horizontal platform will be established, and hemispherical seal for the particle spectrometer canister. These events will occur in rapid succession and, according to JPL specifications, are programmed for 78 min after launch.

The solar panels will be deployed by firing two groups of four apertures in sequence; four apertures will be required for the platform sunatching, and four for the particle spectrometer operation.

Each of the two solar panels will have an area of approximately 28 sq ft. Upon deployment, the panel will be extended into a compact plane. As a function of the trajectory, the solar panel voltage will tend to decrease as the flight progresses, but power available from the panel will tend to increase during the early portion. Maximum current, also drawn from both panels will be 1000 ampere hours, or 1000 watts at 1000 rpm. At the end of the flight angle of attack, it would be 500 watts. However, since more battery requirements will be based on a nominal increase in panel output during the flight.

Power will be supplied by the solar panels or the batteries, not by both at the same time.

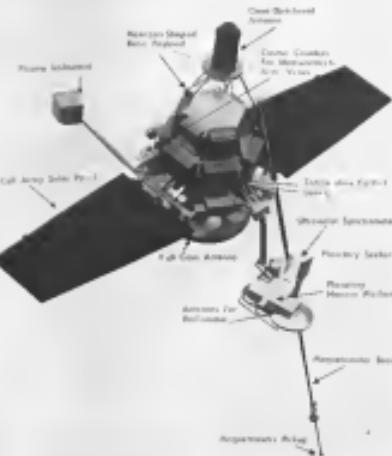
#### **Anti-Subversion Anti-government**

Prior to any maneuver the position of the spacecraft will be determined by the sun, so it is best to shoot along the tail axis, with the solar panels presenting the full blast of the sun and the direction opposite pointed back to Earth. This is called the cruise mode and will be accompanied with sun and earth images which will control cold gassers to position the spacecraft. Flying from JPL's Goddard, Colloidal will determine any error in the capture cause, the required course will be transmitted to provide the proper amount of roll and pitch, and the Infrared interplanetary rocket will be fired, using nitrogen fuel, for steering to provide the

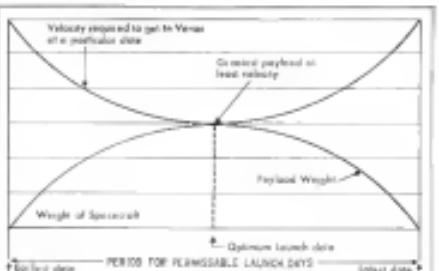
Magnetometer boom and solenoid boom will be extended serially by firing two ignite for each operation at 54 hr after launch, according to JPL specifications.

Because of the hysteresis and  
the glassy boost it delayed until after  
the midcourse maneuver in order to  
minimize the center of gravity of the  
passenger.

A second moderate measure is proposed for the majority. But it is



**SABINE** A Venera Flyby prototype model reveals basic characteristics of the space environment projected to pass within 16,780 km of the planet after 26 million km travel from Cape Canaveral. At this time, most of the data will be stored in a memory unit and transmitted to Earth during succeeding two days in successive passes on the orbit around the sun.



**TABLE II** A Visual guide relationships between payload weight, velocity required, and wing loading in terms of collapse stress.



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**Simulation** is performed by creating within the computer a mathematical model of an inventory

control system. Then the model is subjected to various demand situations. In every case, the computer reports what would have happened had this particular system been used to handle each situation. Of course, both the model and the demand factors can be endlessly varied.

**Here's the important thing:** Through simulation, the trial-and-error method of determining a course of action is performed within the computer—not during the course of your firm's business. This gives you a fast way to test plans under a wide range of conditions before actually putting them

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**MARSHALL SPACE FLIGHT CENTER** now is preparing for the Saturn C-3 configuration to land soft on Earth after its booster stage. Earlier concepts were based on a cluster of eight LR-11 engines. The C-3 second stage would be four P-10 third stage boosters instead of six LR-11 engines. Douglas C-310 is being considered as a first for Saturn stages flight. Drawing shows an S-IV upper stage with aerospike fairings for and off as it might be carried on top of the modified booster.

## Control Duties Foreseen for Space Crews

By Bruce J. Bullock

TOKYO, OAKS—Increasing need for reliance on the heritage of aerospace industry experience to provide optimum designs for space vehicles, especially those intended for reuse, has been indicated at the first international symposium on the potential uses of space.

Promoting this viewpoint was a symposium by Marshall Space Flight Center Director Werner von Braun, who said that of major significance in the Saturn/Apollo program is the elevation of the man's role in ameliorating responsibilities with the aim being to make some of the created functions from the machines and give them back to the man in the chair.

National Aeronautics and Space Administration Space Task Group Director Robert R. Gilruth outlined these needs for the U.S. space flight program.

\* **Aggressive development** of large launch vehicles specifically tailored to advanced sustained space flight programs exploring aerospace experience in flight/noise requirements and techniques.

\* **Development** of advanced boosters for future space flight programs, bringing us and that man to be a vital component of those missions. These boosters should be tailored from the start to the requirements of reuse.

The use of modified Redstone and Atlas launch vehicles as Pioneer Mercury has imposed severe restrictions on

maneuver spacecraft design and operation because of limitations on weight-lifting capability and reliability, Gilruth pointed out.

He said that man day up to such large launch vehicles provides valuable early reentry protection that reflect man's physiological limitations, particularly procedures that facilitate late insertion of man into the spacecraft, a simple solution of equations that will impose ability to launch at the specified time and a very high order of safety and reliability.

As to the latter, Gilruth stressed that greater emphasis must be placed on the application of reentry, descent and landing methods, concepts and enhanced knowledge of the atmosphere in the manner that has been so extensively in the aircraft field.

Detailed consideration should also be given to the use of flight crew reentry and control when such missions are suppose launch phase reliability, he said.

### Large Launch Vehicles

Advanced launch vehicles with greatly increased weightlifting capability will provide no easy short-term solutions to future problems, Gilruth said, since the desire to land on advanced missions has already placed a very high premium on weight control and orbital sophistication. Design of the Apollo spacecraft will call for a large reentry problem that forces a trade-off in the present objectives to determine what compromises must be made.

"We cannot permit old concepts to dominate the reengineering design or lose their place there in the recent planning of the basic space station," Gilruth noted. Design of the Apollo upper stages in the midrange of space mission capability, incorporating such an optimum configuration compromise for launch reliability and landing, is questionable.

"We therefore are compelled to analyze reengineering from scratch to a logical conclusion and make the best possible with little penalty in overall performance," he said. Gilruth indicated that one concept that could should stand for a "non-entangled

### Consist User Costs

Today's system of aerospace transportation will be commanding for the U.S. Information Agency says it is a sharp service. The agency's Director Edmond R. Stevens told aerospace engineers and institutions attending the first conference on potential uses of space that:

"We cannot spend millions for the luxury of using a new satellite system." Stevens stated, adding that his agency's satellite communications will not be a completely new system of transmission but an enhanced one.

AIRPORT WEEK June 18, 1961

landing system"—such as the Mexican parabolic recovery system—in the Russian flights should be adopted.

The single-stage wing of the same order of weight as a parabolic would make it possible to retain an optimum configuration for the space and reentry configuration and still provide a low initial pilot-controlled landing capsule on land or water. Such a wing with a lift-to-drag ratio of approximately five, could be deployed after switch to power fuel selection of the landing area, Gilruth added.

In the context of that nation's space flight program, there can be little doubt that it can be expected that two stages will be made, Gilruth noted. He said that there is a wealth of valuable experience available that could do much to increase the pace and success of the national space program if it could be focused on the unreported research of our many projects and effectively disseminated to other project groups. Gilruth said he did not mean to imply that there has been willful withholding of such data.

### Design Criteria Handbook

A possible mechanism for exercising the aerospace experience handbook might be something along the lines of that used in the aircraft field—a space counterpart to the handbook of design criteria used by aerospace engineers, he indicated. A skilled handful of specialists working full-time developing design criteria for space vehicles is badly needed, Gilruth stated.

Space Systems Division Commandant Maj. Gen. O. J. Kifford emphasized that "It is imperative that we acquire an index of reliability that will be comparable to vehicles capable of operating like the technology at pre-designated speeds and that we enhance our capabilities to support at high speeds. Our flight test program can provide data on problems encountered above ballistic missile orbits in orbit speed. Gen. Kifford stated, noting that a NASA research launch vehicle proposed for the latter part of this decade will attain speeds of Mach 37 and will be designed to survive the higher speeds speeds that such performance dictates."

Additional information on reference on aerospace techniques was made by General Dynamics Astronautics Division Manager J. B. Draper, who noted that an advanced heavy reactor under development by Convair for a very tall tall hull employs a "no glorification-in-orbit" principle, with low solar radiation and heating characteristics. Convair will control the reactors from itself from a manual, probably during the flight mission in retrograde mode for the trajectory to either flight plane. Convair will take every effort again to assist the automatic systems in

a space rendezvous and would also be in command during recovery and landing.

This concept would be operational in the 1970's, Draper indicated.

Decreasing the "whole stable full" of one rocket with which we expect we will overtake the Russians threat requires only a good enough, von Braun lifted the curtain slightly to reveal all details still on plan for the Saturn C-3, which does not yet have full NASA approval, he said. Now that the

\* **Saturn C-3** is designed as a first stage, consisting of the Rockwell T-1 intermediate stage built on the power of Saturn C-1 and C-2 first stages, which are made up of a cluster of eight Redstone H-1 engines totaling 1.5 million pounds thrust. The C-3 second stage would consist of four Redstone H-2 liquid hydrogen boost engines of 180,000 lb thrust each, the third stage is to be six Pratt & Whitney LR-113 liquid hydrogen engines of 15,000 lb thrust each.

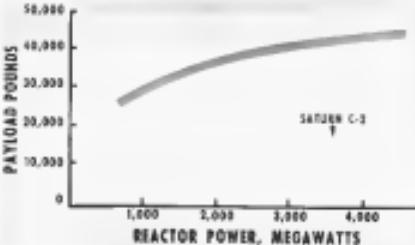
That thrust capability would allow

Saturn C-3 to put some 50 tons of payload into a low earth orbit. If a triple stage goes around the moon or sends 12 tons of payload on a one-way trip to Mars, von Braun noted. As a measure of the capability of the C-3, a two-stage Saturn C-2 could put 10 tons of payload into a low earth orbit or three men into orbit around the moon in Apollo type spacecraft. The three-stage Saturn C-3 is designed to put you around the moon or more than 22 tons in a low earth orbit orbit. It has a 3.5 tons payload on the moon and return to Earth, or put astronauts on Mars or Venus, he said. As yet, Saturn C-3 is a Marshall Space Flight Center concept and not funded as a regular hardware.

\* Two Nova variants were discussed. One a modular Nova with interlocked upper stages would have as a first stage a cluster of eight 1.2 million pound thrust P-10s, two E-1s as the second stage and four J-2s as the third stage and would provide a payload capability of 160 tons in a low earth orbit at 90



**RIGELOLLO WING** is return space-Sounding rockets to the Atlantic Missile Range or to Goodfellow Island is being studied. Guidance would be from the ground and would initially use laser beam steering the wing to the links.



**NUCLEAR STAGE** (depicted on p. 61) would give Saturn increased capability.



PHOTOGRAPH COURTESY OF PRISM

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NUCLEAR SATURN is regarded by NASA as a possible Nova stage because of its guaranteed payload.

now an an escape route into space. ■ Modular Nova with one power plant consisting of the previous stage, but with additional propellant tanks for the two stages to provide a greater escape velocity. The planned Nova would be able to put 10 tons in a low earth orbit or provide an escape payload of up to 23 tons, von Braun estimated. Some reason could put them back on the moon and return them to earth, leaving behind 20 tons of equipment and equipment to support a lunar base, he added.

■ Nova with a smaller third stage could go into orbit around Mars and return to earth. Later on . . . the Nova would give us the most direct approach to explore shortstay and later on man would be able to land on the Moon and return. ■ The second stage of Nova would be a first stage of eight Blockade 4's. If the second stage would be another modified Saturn C-2 booster having four F-1 or eight J-2's, with the third stage comprising a non-BOI 400 lb thrust J-2. Von Braun said he expected that the U.S. would be in first position, nuclear rocket engine, in 1963.

Von Braun noted that on the Japan



## SWIVEL HIPS ARE AN ASSET

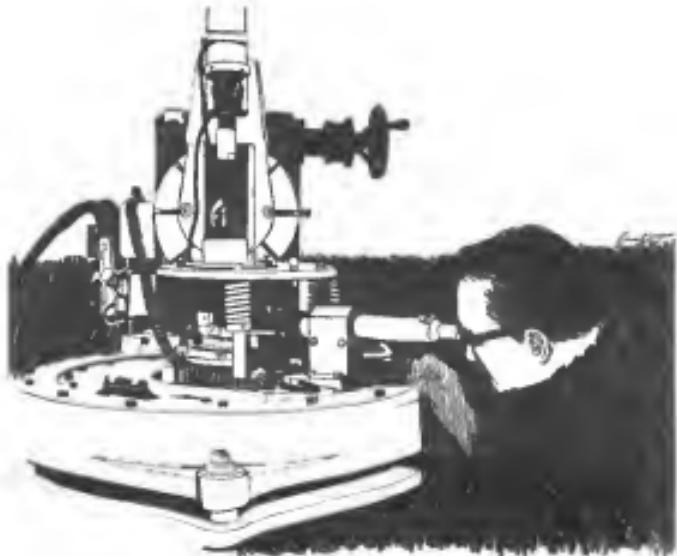
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C.F.'s first stage cluster of eight H-1's, the four outer engines gimbled up in 10 deg. and all six LR-115 liquid hydrogen engines in the second stage gimbal to provide necessary course corrections.

Possibility of reducing Saturn boosters and some upper stages, moving a Rapallofing parapet, was considered feasible by Von Braun. Techniques would be to guide the staged stage to the ground either at Cape Canaveral or at Cape Kennedy, adding the additional weight of water. This would save eight rocket motors at 400,000 lbs of liquid hydrogen with a boost at the stage being added by ground rockets or tank could add costs to a ground-based complex to calculate energy management of the expanded stage, and perhaps cause end-of-stage or any interference to the staged stage. Maneuvering could be accomplished by putting fins attached the fin bar in the stage in order to adjust course as the stage approaches the landing strip. These landing fins, attached to the midplane of the recovered stage, could ease it out as it rolled precariously toward the ground pressure of 110 psi, where it would be broken to start free-falling when landing speed would be approximately 60 ft.

The other alternative, Seven stages extrapolated to Cape Canaveral via water hangar, modifications prior to launching the Douglas C-133 transport aircraft is being studied by NASA.

One such proposal envisages carrying the first four stages atop the C-133 with an completely enclosed capsule which could be used for other large cargo when the stages are not being handled.

An upgrade cargo pack would be tied right in modification involving addition of small outer fins to provide additional stabilization. The proposal to carry a first stage would probably require a complete set of the tail to include fins and rudders to provide necessary stability and control and a vertical tail surface.

Wind tunnel studies by Douglas and NASA indicate the feasibility of the criteria, according to a Douglas spokesman. Indications are that negotiations with NASA analysis has Right articles and Douglas believe it could have a fully modifiable payload flying a year from go-ahead.

An shipment of Saturn stages from Sacramento, Calif., to Cape Canaveral, for example, would take some 20 hr flying time, compared with approximately 24 days for combined barge and ship transport for a similar trip via the Panama Canal.

Von Braun noted that an alignment using drogues or gliders has also been proposed, but that he does not consider this as promising as the Douglas proposal.

## PROBLEMATICAL RECREATIONS 70



If  $x_1 = 10^{\circ}$ ,  $x_2 = 10^{\circ}$ ,  $y_1 = 10^{\circ}$ , and  $y_2 = 10^{\circ}$ , show that the product  $x_1 \cdot x_2 \cdot y_1 \cdot y_2$  does not vary at all. —Contributed

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**ANSWER TO LAST WEEK'S PROBLEM:** He divides the bricks into 3 groups of 3, 3, and 2 bricks. Then he weighs the 2 sets of 3 bricks against each other. If they balance then the heavier brick is in the group containing 2 bricks which another weighing will easily tell. If they do not balance then he weighs 2 of the group that was heavier on the first weighing. If these 2 balance then the heavier brick was set aside. If they do not balance, then the scales tell which is the heavier brick.

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## Minuteman Vectorable Nozzle Detailed



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Promised. N. J.—Vectorable nozzle for Minuteman solid-propellant motor of the USAF's Minuteman has been developed by Aero-Portland, Inc., as one of two parallel projects on first-stage nozzles for the solid fuel ICBM.

The Aero nozzle, which passed its preflight readiness test (PRT) nine days ago in a series of 12 static firings with 45-second lengths about 300 lb impulse, cost more than 10% of that figure in the mechanism which moves the nozzle.

Materials are non-consumable, although unexceptional, said Gator shall o mandrelled 4130 steel with a plastic sleeve and cast iron. There is a graphite can liner and a refractory metal skirt section.

The two part nozzle divides a little upstream of the boost section. Motor exhaust from the propellant is directed through a passaged-out exhaustible skirt which strengthens the flow nozzle. Downstream of the nozzle, motor heat, starting conditions along a spherical surface where gap is filled by a refractory O ring seal.

Each of the two or four nozzle sections in one plane will rotational 90° as needed from the center of the nozzle throat.

Aero's nozzle design was one of several submitted to Thielke Chemical Corp. and the Air Force in competition for the job. First selection went to a competitor with Aero second in bidding. About a year ago, the Aero effort was moved by the Air Force from Thielke to Portland.

The company feels that its choice as a Minuteman subcontractor was dictated by two aspects of its approach to the problem:

- \* Simple mechanical design, which the company's chief engineer, Harold Monk, says is the simplest of any competing designs. "If you designed a fixed nozzle to the same standards of today," said Monk, "it would have to weigh almost the weight of the nozzle itself." The first nozzle, and its control system, were only changes to respond to "We've only made material changes since the first design."

- \* Aero-Portland's shop facilities, which enable it to make changes or fixes with great speed, compared with larger organizations. "The shop has been able to knock out changes over the weekend when we needed them badly," explained Aero President, Elmer Bremner.

"They'll get engineering data on Friday night at 8:00 a.m. by noon, and the



TECHNICIANS at Aero-Portland, Inc., install the actuator that vary the direction of the thrust vector of the first-stage Minuteman motor. Above, static-firing mechanics assemble and package complete nozzles at the main plant at Springfield, Me.



nozzles would be fixed and shipped by Sunday night.

Aero's work with this type of nozzle began about five years ago under a contract to Thielke's Elliston division, then working on a pre-Minuteman program aimed at demonstrating the feasibility of using solid-propellant rocket motors, combined with thrust augmentation and control. Design and build of packages, executed under that contract, marked Aero's entry into the business, and of the nozzle development program.

The company worked with Thielke on early stages of Minuteman, getting a nozzle about the size required for a second-stage engine. It was a mon-

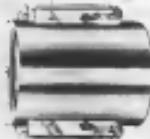
olithic nozzle, completely machined, but designed for short duration. The first nozzle were shipped to Thielke's Elkhorn, Md. division and field tested.

With these nozzle, it was possible to fire, move and replace the nozzle, nozzle being and for open. Right after Thielke got the contract for first-stage engine on the final Minuteman project, Aero got a follow-on test for the vectorable nozzle. But the requirements were so much more severe than the earlier nozzle, a fact that Thielke let other subcontractors in on.

Air Force also let a couple of subcontractors for the same thing, so that Aero ended up in competition with

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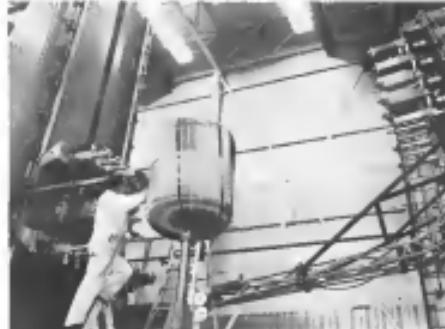


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**Filament-Wound Chamber Seen for Polaris A-3**  
Lightweight, high-strength filament-wound chamber has possible use in second stage of Navy's T-3300x Polaris A-3 is fabricated by Avco General Engg., Azusa, Calif.

Curtiss-Wright, Kibbe-Hines, Alton Division of General Motors, Bondurant, Thompson-Russell Windhambridge.

First of the missiles to be fired was "Alpha" in January 1959. But all the missiles ordered have in Platz Iwerk and in April Alpha was picked as a testbed conductor for the warhead. In October 1959 they got the guidance, and in weeks later—in December—Polaris delivered the first part.

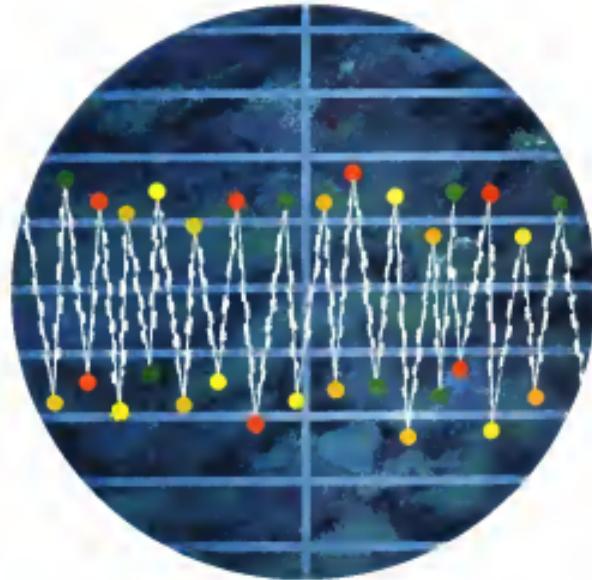
It was fast, and brief, but before firing it had stood no longer than one body day's notice. Bondurant and

Concord's development work—a task unique—one of the most difficult, but single pointed and of one-quarter the length of the full-size Minuteman first stage—showed some of the difficulties will determine the need for a flow straightener, the exhaustual band added upstream of the nozzle.



#### **Fuel Purifier for Atlas Missile**

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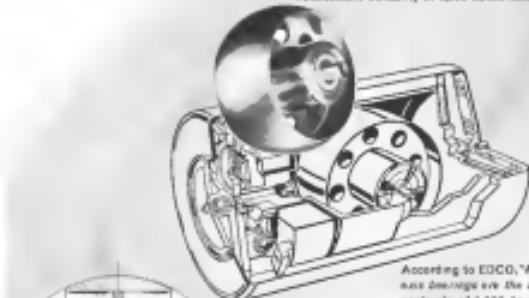
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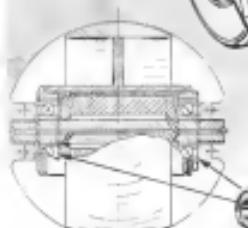


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## French Display Research, Combat Rockets at Paris

Stabilized experimental vehicle (left, above) was developed by CNETA, French equivalent of National Aeronautics and Space Administration, for high-altitude target precision at speed exceeding Mach 5. Two test models have been lost to about 12 m altitude. Third model, shown at 20th Paris International Air Show, is intended to be fired in the next future. Solar single-stage high-altitude research nuclear flight motor, shown displayed at the Paris show was developed by CNET French procurement research organization (CNET) Centres (left center, above) appears to be two Becker rockets used to gain greater altitude capabilities. SEPR 730 solid-propellant booster (right, above) for the stabilizer, produces 15,000 lb thrust for 20 sec before burnout. Total booster weight is 2,310 lb. Main K-110 long-range solid-propellant air-to-air missile (below) designed as a follow-on to the Matra 51A, has a range of approximately 30 ft, and can be equipped with either infrared or electronic guidance systems for all weather capability. A larger first stage insures maximum initial acceleration while the second stage carries the warhead on to the target. Total length is approximately 9 ft. Photo at right below shows the rear control surfaces of the Matra 510 which control pitch and yaw motions during flight.



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## Semiconductor Crisis Looms Over Pricing

By Barry Miller

Semiconductor component sales is being a serious issue which not only impacts the very existence of some transistor and/or diode makers but also could endanger high-quality devices required by the industry's principal users—military equipment and test instrumentation.

Stated simply, the main point is that the publishing industry of which was never seen and those authors should have arrived at the chaotic price war by negotiating the royalties. Publishing houses have tended such proportion that the price of a single title, typically can start in amounts as high as £100 or even more. Large numbers of devotees are being charged on the market and some responses although it may find themselves selling products at less than cost in the hope that profits will come from higher prices on tomorrow's sales.

Semiconductor analysts, economists, and marketing people interviewed in recent weeks by Aviation Week are frankly worried, and few, although not all, conceal their concern. The pessimistic slant of weaker firms may have a ring to it, but no one is certain who will emerge

Military men may suffer along with the supplier according to a number of executives interviewed.<sup>1</sup> The men can be shortchanged on the salaries and benefits he has during the shutdown period at some vendors and concern is raised over whether their competitors' low prices.

Do the numbers at least, the semiconductor company's earnings appear to be in reasonably good health. At \$3.7 billion sales volume, INTEL can claim the highest in its short history. These sales are steadily climbing upward, though at a retarded rate. The growth of the industry's projected dollar volume for 1965, made by the company's management, ranges from \$7.50 billion to \$8.5 billion. Earnings statements of publicly traded semiconductor companies looked uniformly favorable until recently.

These bright signs tried to obscure certain potentially disturbing features about this fast maturing industry, however. These features, cited by industry members and called from available statistics indicate:

denotes will be sold below manufacturing costs by companies trying to dominate large inventories, attempting to buy them way into a particular product category or to force favorable cost sales balance.

• Dollar value decline—Rate of inflation in dollar value terms for defense and construction has been dropping (AW Aug 15, 1986, p. 91) even though demand continues to increase, after long standing price. Although the average price per million square feet of office space has been falling steadily since 1947 from \$117.75 in 1947 to \$73.13 in 1985—other wholesale price starting began to fluctuate according to statistics in the *Platinum Products Resource Agency* (EPRA) and Department of Commerce's Business and Defense Services Administration (BDSA), these

**Symptoms of the Semiconductor Times**

- Sales, profits, earnings: Despite quarterly earnings statements of Transistor Electronics Corp., which recorded the second highest semiconductor sales volume for the industry in 1960, reported net sales of \$7,512,649 compared with \$55,215,812 for the same period last year. The company reported a net loss of \$659,304 for the quarter ended Mar. 25, contrasted with a gain of \$1,116,162 net for the corresponding period in 1960. For the three-quarter period ended Mar. 25 it was \$11,056,996 against \$55,215,812 for the three-quarter period of the preceding year. Earnings per share were reported at 43 cents during 1960, cents and net income was \$2,764,480 against \$7,862,471 for the

## Symptoms of the Semiconductor Times

- sales, profits, earnings: Jp-Late quarterly earnings statement of Thomson Electronics Corp., which received the second largest semiconductor sales volume for the industry in 1980, reported net sales of \$7,310,649 compared with \$47,811,811 for the same period last year. The company reported a net loss of \$895,004 for the quarter ending May 25, contrasted with a gain of \$1,219,126 last year. Net sales were up 10 percent from the three-quarter period ending May 25, 1980, \$11,596,998 against \$53,121,212 for the same period of the previous year. Earnings per share were reported at 40 cents for the quarter and net income was \$2,707,649 against \$7,840,747 for the like 1980 period last year.
- Dr. Robert L. Lasker: Transistor producer utilized the relatively short time span to a combination of factors including reduced dielectric costs, timely heavy startup expenses as in a new \$400,000 wafer plant and aggressive pricing. Shipments in April, however, were very sharp, weaker mid-April.
- Setting low end of production goals—Norton Co., newly acquired division of Hughes Aircraft Co., will attempt to expand its lead with potential customers with its solid-state television and color TV technology, which may do more to further weaken market share of established color TV manufacturers. Norton's low end of bell distribution devices had no profit, so three price levels were taken into account in setting production goals. Norton will try to show these three devices may be used and exploit its cost containment possible application for them.
- "Spin-off" silicon diodes: "Spin-off" sale of the power diode electronic quality devices covering off the low end of bell distribution curves for different production runs was completed by Hughes Semiconductor Division on May 15. The site was line-and-shunt diodes, older line-and-resistor diodes and diode modules. An important aspect of the site was a unique effort to examine different effects of impurities in semiconductor materials.
- Semiconductor industry—A microwave photonics unit was set up recently within Research and Development Laboratory of Philips Semiconductor Corp. to explore applications of semiconductor technology to microwave components. The microwave region was one of the first areas in which semiconductor devices were applied but it remains relatively unexplored and is widely regarded as a promising direction for future semiconductor growth. Dr. Louis H. Saltz Jr. will head the section.
- Infrared electronic stevens—in a move to cut the unit's production costs, RCA Semiconductor at Mahwah Division has initiated a "process improvement" program under which it will provide the most comprehensive electron microscopy, environmental and life data ever offered on semiconductor transistors. For each lot shipped under the program, a certificate of compliance and price will be given for the samples with specifications, allowing the user to reduce or eliminate many testing requirements.

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*What it does...*

*What it can do*

Pyrolytic Graphite—now commercially available—is a polycrystalline form of carbon produced by gas deposition. It exhibits a metallic behavior (high conductivity) in the planes of deposition, and a ceramic behavior (low conductivity) across the planes.

Some of its unique properties include: high strength at high temperatures up to 5000°F.; impermeability to gases and liquids; excellent thermal and electrical conductivity parallel to the plane with insulating characteristics across it; is very lightweight.

Produced as a coating on commercial graphite, it can also be built up to sufficient thickness for use as free-standing parts. Pyrolytic Graphite is well suited for many space, missile and elec-



It is a natural difference between ordinary graphite (left) and the new pyrolytic graphite (right). Both are made from the same raw materials, but the pyrolytic graphite has a high degree of orientation with no porosity.

tronics applications, including leading edges, rocket nozzles, and casings for nose cones.

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## Western Semiconductor Items

Seven western semiconductor manufacturers are reported to account for \$27.9 million in semiconductor sales during the current year according to estimates in a survey by Arthur D. Little, Inc.

The seven companies and Little's estimates of their projected sales for 1968 are: Fairchild \$18 million, Hoffman \$15 million, International Rectifier \$15 and Sim, Motorola \$17 million, Pacific Semiconductors \$3.1 million, Rhone \$17 million and Texas Instruments \$2.8 million.

Estimates of other sales of these companies in 1968 were given in Little's report: Fairchild \$74 million, Hoffman \$11 million, International Rectifier \$19 million, Motorola \$26 million, Pacific \$18 million, Rhone \$6 million, and Texas Instruments \$10 million.

A number of western semiconductor firms, including Hughes, did not participate in the survey. Hughes' sales are estimated to have been between \$15 and \$17 million in 1968.

Little's estimates are based on surveys with exception of the area firms and on its own information.

We do the productive aspects of the industry. A Department of Defense source, concluding among 60 semiconductor manufacturers last year, reports that four years devoted to research, development and production for these companies now have 11 months as it is December, 1975, to 4½ months as it is December, 1975, to 4½ months as it is December, 1975, to 4½ months as it is April of 1969. The source adds that he believes that as of April of 1969, these semiconductor companies planned expansions which would double the April, 1969, facilities by the end of 1969.

While many companies carried these plans in the face of impending pricing difficulties, some plans were never cancellation and have not been forthcoming.

A reader of these proceedings in Avantage: Were we to continue in this new direction? But even some of these companies conclude that the gap between productive capacity and demand is narrowing.

• Rate of introduction of new devices—The rate of introduction of new models and novelties, which characteristically has been high during the first years of this growth industry, is falling off. Fewer new types of individual components are appearing on the market. This occurs, this argument reasons, that the new company as the smaller, more flexible shop, which could bring into production quickly, had an advantage it had lost over

larger company in the days when production lines were changed frequently to handle the newer devices.

• Number of companies continue high—Number of companies which manufacture semiconductor devices, or have announced their intention of doing so, continues to run as close as 100. Changes are occurring, however. A half dozen companies, such as G. F. Clark, have dropped out of the semiconductor business since the end of World War II. Others, such as Transistor, were acquired by larger firms. Transistor has now been replaced by newcomers such as Krelleff-Dickson Electronics, Microelectronics and Components. But the total number of firms in the business remains relatively large and stable.

The large number means rough competition in the semiconductor industry, in terms of number of companies, has let its peak.

• Health of companies dominant—About 10 or 12 companies currently divide the major share of the semiconductor business. The first 10 firms account for 75% of the market, with 1990, according to the Joint EPA/EDOA/Semiconductor Source of Production Qualities for Electronic Parts as reported in a recent Department of Commerce Bulletin. The report does not identify the first 10 by name.

The top 10 a year later and show no appreciable change in its influence of a 55.2% market lead to Texas Instruments (100%), Transistor (95%), General Electric (40%), Radio Corp. of America (35%), Philco (34%), Motorola (28%), Fairchild (24%), Raytheon (22%), General Instrument (24%) and Pacific Semiconductors (20%). Western Electric, which manufactures integrated circuits of semiconductor components for service and internal use, may also be in the top group.

Using these numbers, here are averages of figures occurring in a report on the Western Semiconductor Industry prepared by Arthur D. Little, Inc., one finds that these 10 companies account for roughly 75% of the 1968 sales figure. Other companies with smaller sales volumes hold strong or dominant competitive position in specific niche, recycler, transistor or other off-line.

It is difficult to arrive at a consensus among the various publications about conclusion of a general price plateau. The present choice pricing instances bear the size of the factor—size of these sales level—estimated by these officials are:

• Overcapacity—There are too many firms producing and selling semiconductor devices and their total productive capacity exceeds current demand. Some officials, however, do not accept the latter part of the foregoing statement.

• Overinvestment—Excessive venture capital has been and still is available for

## Environmental conditioning for fire control systems



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Representative of AIResearch progress is this air-to-air environmental conditioning package which uses the integral heat exchanger and cold plate cooling unit as the base and mounting frame of the pressurized enclosure for the fire control system transmitter. Net weight of that unit is 9.5 lb. with a heat rejection of 425 watts.

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### Ball Bearing Simulator

Ball bearing simulator, developed by Sperry Gyroscope, simulates bearing life tests in one tenth the time previously required. Results can duplicate performance of any high-speed, high-temperature low-load-bearing such as those used in gyroscopes, motors or computer memory devices for aerospace. Originally developed for company's own test Sperry now has off-device for sale to other companies.

conductor industry's customers is the view that the industry's current problems manifested in major price declines is mainly the result of healthy economic growth of supply and demand starting to make itself felt in the industry at a time in the election year and even other industry in a free economy. The semiconductor people may accept this but an industry that was not characterized by the growth period of the other industry that they feel stronger and aggressive. The situation. Not only does it undermine confidence in the market but also the abundance of financial backers for public ownership of electronics stocks and eager to snap up new chartists available to its companies is lessening.

The second ground-holding of a free market this view goes on, is disturbed by the "explosive" in potentially explosive market which help keep companies alive. By "explosive" market is meant that large share of business that a company can not have fed up through agreement with an equipment manufacturer, a military agency or with its parent corporation in the rest of the semiconductor division in addition. Furthermore, several of the major share of sales of the top 10 companies are accounted for sales of defense contractors to sales of defense. Military purchases for a single major weapon system account for over half of the sales volume for another top-10 company, which is the only qualified source for the item.

While most semiconductor divisions

or subsidiaries of major ones do not now have "explosive" markets in their parent corporations, and are quick to deny any overall market advantage by their association with a major aerospace or avionic equipment manufacturer, the possibility of developing such as separate market in the future seems clear. The going got too tough. Such a possible basis is suggested by the tendencies of certain semiconductor firms to specialize in device types of particular application to their parent corporation.

Thus, the present semiconductor industry, like segmented now, is an oligopoly in certain and a simple case of the unsuccessful entrepreneurs closing the door of his shop when his funds are exhausted.

The earliest collapse of semiconductor component prices, temperature at least apparently, has taken hardly for the industry. After all, the market for chips, delivery in quantity, the vendor's concentrations are always as full. Specification sheets are not sent easily through the mail at the user's request, as they once were but an oligopoly is available from the vendor's eager salesmen.

The buyers' market, or a variation of it, might well continue after a short time. The military user can always be assured that as long as his market exists he'll be able to find companies anxious to supply it, competitive people yes.

### Quality May Suffer

A more frequently expressed concern that the military user may suffer either now or later is how now and later. The lesson here appears to be the consequences of mass imports in the industry that the quality of domestic will suffer. As prices are cut, the market will eat his quality control to save money. He will risk his reputation and perhaps his business which over all depends on his products in the sector that he can't afford to do. The market must seriously sacrifice the reliability called for in the device specifications.

In addition research and development, which have consumed huge expenditures in the semiconductor industry (\$70 million in 1959; \$10 billion of which were governmental funds) (AW Apr 24, p. 81) is another expense cost for the component market to reflect. But this is his problem. The first investment in research and development which helps no obviously to do and cannot help him survive now is his guarantee of staying in business tomorrow.

From my own knowledge and experience in existing components. Hence, the very conclude the lower may not only be produced as reliable as today's devices but he may not get the reliability and new devices at the price he will need



### SKYBOLT



This new USAF weapon now under development will combine the range and mobility of the jet bomber with the speed and the off-site-to-target capabilities of the ballistic missile. Yet Skybolt's weight carrying capacity will match and operate with the same reliability and accuracy of ground-launched reentry vehicles.

**Environmental conditions**—The reentry vehicle must withstand heat after high altitude and nose fairings closed to bumper ("booster")—the B-52 and the B-57 bombers. At best protection system must endure repeated thermal cycling from ground take-off temperature to -165° F. At cruise attitudes if needed, it can be exposed to # entry temperatures of 1500° F.

**Extended life**—Skybolt's reentry vehicle must have a useful life of several years, through repeated storage, thermal cycling, and return to storage—all with a minimum amount of maintenance.

The Skybolt missile system is being developed from tested and proven engineering principles, resulting in rapid program advancements at great saving to the American taxpayer. The Missile and Space Vehicle Department of General Electric's Defense Electronics Division is developing Skybolt's reentry vehicle.

### GENERAL ELECTRIC

**SKYBOLT** is being developed to add a new dimension to America's growing missile might. Launched from an airborne B-52, it is being designed to fly through space toward targets more than 3000 miles away. The reentry vehicles for this advanced USAF missile are being developed by General Electric's Missile and Space Vehicle Department under contract to Douglas Aircraft Company, prime contractor for Skybolt.

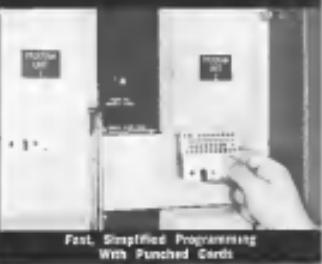
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TACT systems won't become obsolete—can be expanded to accommodate future tests or extended to testing printed circuit boards, modular circuits, etc.

**High Testing Accuracy** results from reduction of contact and signal leakage and interference. Test accuracy coding has been reduced to approximately one-tenth of other designs offering similar testing capabilities. **Reliability of Testing** is maximized by punched-card programming and remote control of option test circuitry. Program cards can be rotated and used indefinitely, assuring high repeatability and a permanent record of test conditions.

**Nonbiased Personnel** can operate TACT systems with minimum training. Programming can be accomplished in minutes without circuit board or plug-in strip changes.

them in the future if R&D funds are using the resources of the peace war.

A contrary argument, at least with respect to reliability, reasons that reliability should be and is inherent in the process of making components. The techniques of mass devices are simplified and failure mechanisms isolated and recognized, reliability will be increased. This will also lower the manufacturing cost. By improving reliability the maker lowers his cost and puts himself in a better position to compete if the producer with the lowest costs is among the survivors he will be supplying reliable devices.

In one other respect the nonspecialist user is better off by the price war, possibly without knowing it—when it comes to tooling. They use the power-hungry batch tools at the user's plant as learning aids and contributing to the depression in prices. Component buyers, on the other hand, profit by economies of size in many companies and the buyer's desire to be a "few" to his employer too frequently buy components at the lowest price point, roughly equivalent delivery times. This enables the price cutter, who can be concentrating on reliability, to get the business.

One example of such a situation is the company which has been forced to use the marketing manager of a component firm. His company, call it Company A, shared in prior to \$3.75 per device in a particular competition. Company B was low bidder, offering the device at 95 cents each. Company A decided to trade the lower firm for selection, reasoning that Company B could not meet the specification of the quoted figure. Company B began delivering its devices which did not fit to meet the specification.

The buyer, using a new source and not having time to adjust to Company B, had to pay 95 cents. Having purchased a third company, Company C, asking it to supply the device, Company C was told that the previous vendor sold the device at 90 cents but was not informed that they failed to meet specifications. At issue is the cost difference. Here again the small refiner who can buy in short lot, cut corners and meet vendor R&D will be the last.

**Selected product sales**—Companies selling to certain strong industry segments will have no problem growing, and production at large volume markets. Small volume devices may have to be dropped. Another group of companies, willing to settle for the role of a specialty house, will either stay at home or concentrate on certain industries or geographical areas following either of combinations of these.

**Competitor marketing**—Salesmen, different manual marketing techniques, should work for you as the industry will be contend. Component sales forces with effective selling methods must be included. Published company with well organized distribution and sales representatives will have a distinct advantage. The need for marketing capability, which occurs with the



## Mobile Communications

Mobile communications systems communications system, AN/FRTG/C-3A, developed for the Air Force by Texas Instruments Engineers, Inc., a Northrop subsidiary, includes two 25-ft diameter antenna units mounted on four-wheel trailers and three truck-mounted transmitters. Two of the three, shown above, house and transport the 113-watt transmitter uniquely designed receiver and associated gear. Third unit, not shown, houses two 150-watt ground stations.

acquired strength, over discourage formation of new companies and could hinder area, weaker firms.

**Willingness to accept small, remote-area profit margins.**

**Research and development**—The company which hopes to survive must continue to invest in its future in strengthen research and development which will lead to new and better products. Receiving a good share of its profits in R&D can be bad news, but maybe that is the key to the success stories down through the years. Here again the small refiner who can buy in short lot, cut corners and meet vendor R&D will be the last.

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fabrication of components may enable a company to sell products more cheaply than competitors. This should result in lower costs, capture component quality, and put the maker in a better position to compete.

**• Sound manufacturing practices**  
**• System compatibility**—Component maker with in-house or co-operation without expansion may benefit when certain functions become significant products.

## Shakeout Due Uncertainty

Few people in the semiconductor industry will hazard a guess about when and how the shakeout will take place. The integrated circuit may take place and pass within a few years—but perhaps not in the form predicted, a whetting of the industry down to seven or eight firms. Most companies around today may still be in business, but perhaps in different forms. Competition in particular device types may cause an entire device type to specialize or branch their lines into semi-conductor devices.

As the number of high-line military-type devices shrinks, which is expected, the competition may naturally be tougher between the remaining companies. In the high-line area, the doors are closed. The remainder might push the specialty line where products fall into the low-line category.

One effect current price tagging may have is to make businesses and dealers, which were previously too expensive, attractive in maintenance, industrial and after-field. This could have a bootstrap effect—stimulating the use of these companies and increasing the demand, but probably not enough to seriously deter current price cutting.

Hoping to find a market in Asia, through a local distributor, may encounter such difficulties (costs) will probably not hurt the supplier they bid when the industry had a smaller financial line, according to one view. That should allow one company develop a significantly new device which can create new demand at future replacement of older devices. If world not have the desire to impact one or a whole series of new products had in the past several years.

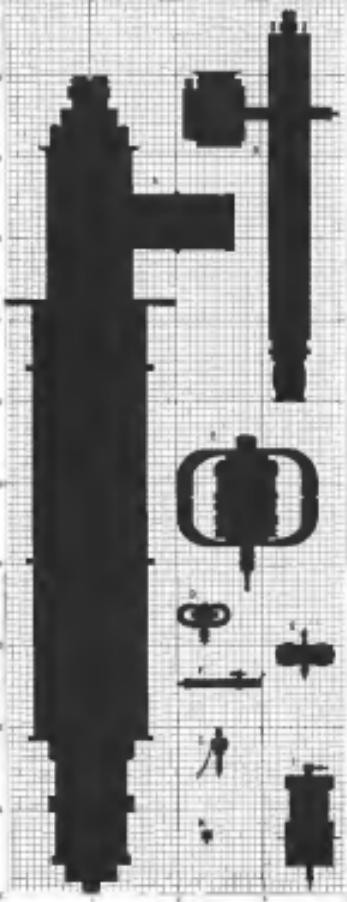
New manufacturing techniques are coming in, some are very popular, people feel, and some companies which seem not be using long and to get the maximum return of having a big factory is the industry are probably a thing of the past. This is largely true, they say, because the new company no longer has the power to create a market as it once did. If it has a good down concept, which can be made profitable, it can be deployed to achieve.

To add to all the difficulties of starting is a highly competitive market—attracting bidding for an undertaking



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case potential business value that is no longer in existence with spending cuts and lag profits; the need for a quality marketing force, research and development capability, able people in scientific engineering and management positions—and the likelihood of new companies emerging with the ingenuity there never did disappear.

Other signs on the horizon which could spell further trouble include a new version of escape for the semiconductor car industry and a new "Space competition." Device manufacturers forced by foreign companies and sold here naturally offer a debatable amount of competition to domestic producers but only in international and possible industrial device types. Should foreign competition step up, domestic suppliers may concentrate more heavily in military types to escape the heat of foreign competition. Alternately, foreign suppliers may seek military qualification on some basis.

• Emergence of materials supplier—Materials suppliers are playing an increasingly active role in the electronics part in processing raw materials down which semiconductor properties are made. Component makers seldom grow their own crystals now and should the word continue, the supplier can offer completed packages at extreme prices. The component maker's function then should be to attach leads and encapsulate the devices.

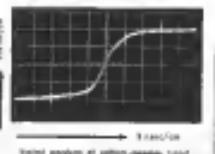
• Systems under competition—Systems and equipment manufacturers especially aerospace, avionic and computer firms which are robust users of semiconductors, are showing signs of an expansion in the semiconductor industry's territory. Many aerospace and avionics firms have their own semiconductor divisions, others, such as Aerospace Board Areas, are known to be shopping for semiconductor acquisition. Still others—Lockheed, Republic, Douglas and General Dynamics—do compete in component research. Small wonder that component makers, based on membership on Electronic Industries Association, have come to the conclusion which was hard to come by, namely, that their competitors, name and manufacturer, are on the nosebleed end they are not.

• Functional circuits—Slow but certain industry trends toward functional devices—semiconductor blocks which perform functions of a circuit rather than a component—will in all likelihood change the character of the industry from a semiconductor component in a semiconductor fabrication industry to the future. Success with these of solid-state circuits which employ many of the techniques the industry has acquired in the past 12 years, will inject new life into the industry, will open new areas

## TUNNEL DIODE SWITCHING TIME MEASUREMENT



A conventional test method of testing tunnel diode effects involved applying an alternating voltage across the junction. This is often done with the current source in the Type N Unit. In this it is not in the circuit loop, because the unit has two terminals, one for the current source and one for the junction. This is the Type N Unit. The Type N Unit is a probe which is applied to a diode or junction point at a rate of 1000 cps. The probe is connected to a pulse sampling scope having a rise time of 0.6 nanosecond.



Typical waveform at switch junction. Used prior to Tektronix Model 500 Pulse Function Testers.



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Type N Sampling Plug-In Unit  
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From research to full production, Tektronix designs, manufactures, and markets a complete line of electronic instruments. These include: 1. Oscilloscopes (Model 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 5100, 5110, 5120, 5130, 5140, 5150, 5160, 5170, 5180, 5190, 5200, 5210, 5220, 5230, 5240, 5250, 5260, 5270, 5280, 5290, 5200, 5210, 5220, 5230, 5240, 5250, 5260, 5270, 5280, 5290, 5300, 5310, 5320, 5330, 5340, 5350, 5360, 5370, 5380, 5390, 5300, 5310, 5320, 5330, 5340, 5350, 5360, 5370, 5380, 5390, 5400, 5410, 5420, 5430, 5440, 5450, 5460, 5470, 5480, 5490, 5400, 5410, 5420, 5430, 5440, 5450, 5460, 5470, 5480, 5490, 5500, 5510, 5520, 5530, 5540, 5550, 5560, 5570, 5580, 5590, 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**PRECISION NAVIGATION** today is far from the art as it was practiced even 100 years ago. The first charts were crude diagrams with no reference to the earth. The first magnetic compass, developed perhaps over a thousand years ago, was made from a needle thrust through a straw and floated in water. These ancient methods have since evolved to celestial navigation and now inertial navigation systems that can determine a ship's position within a few feet of its actual location on the earth's surface. Northrop — Precision Products, in developing the primary sensors in these advanced inertial navigation and stabilization devices, has contributed not only to the basic art but to setting standards of performance as well. Northrop has unique career opportunities for scientists and engineers in advanced design, production and application of inertial gyro and devices.

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lets and tend to exceed many of the factors causing the industry's plight.

Companies intent on remaining significant factors in the semiconductor industry are pursuing this goal. The first results of some of these (Westinghouse, Texas Instruments, Burroughs, Radio Corp. of America and Philips) have been reported previously.

The ultimate solution of the scenario factor concept can only be postposed as the insight changes its character with a market breakthrough made possible neither by state subsidies nor deficits in resources but by function growth induced from the techniques of sustainable sector technologies.

**FILTER CENTER**

**P-N at P-N Sulf Cells**—It was left to decide which type of solar cell, the conventional P-N (homojunction) diode or the newer type, NIP (pseudohetero diode), should be used.

Island Air Photo showed a more or less intact nuclear reaction as special agent John D. Strode, laboratory witness Dr. George Dennis, the nuclear conducting experiments on radiation resistance of solar cells for National Aeronautics and Space Administration. Army announced last fall that NACA all appeared were resistant to heavy energy radiation. Some time later it was shown that most of the cells had been damaged by the test. On Dec. 17, 1958, at 1:15 P.M., the first atomic test based on the use of the NACA space cell, NACA cell No. 12, was conducted. It is believed that the ability of solar cell to withstand radiation may be tested by a number of factors including temperature. These NACA cells can be made to work as good or better than the standard cells. The NACA cells are thus called "NACA cells".

**Navy Seeks Infrared Sensors**—Navy is seeking infrared signal sources for passive systems capable of operating through two windows found by the Russians in the long wavelength regions of infrared (around 9 to 12 microns). Making a man-made antenna at those wavelengths is largely a question of finding the right materials.

**P Thermotropic Materials to Be Featured—Materials suitable for their unique energy conversion will be the topic of a complete session at the Fall Annual AIChE Seminar/Conference, to be held at the Ambassador Hotel in Los Angeles Aug. 30 through Sept. 1. Other sessions will cover thermotropic materials and other plastics.**

**P**Single Crystal Solar Cell Photoelectrodes and photoelectrolytes, contrast single crystal silicon all thin films will be described next. At first, Solar Cells to one of them at about a dozen billion watts of them around the world will not work as expected. Finally, the last section will discuss the effects of potential advantages over conventional cells including use of less material and reduced weight and better utilization of sunlight or space vehicle configurations. Also this research in part has been with photovoltaics. Short because of difficulty in growing large single crystal materials and then in finding suitable substrates for them. Polymers today have however caused much interest in the efficiency obtained with single

► **Saturn Launch Communications**—A 215-station voice communications network will be established at Complex 36, the Saturn C-1 launch complex at Cape Canaveral by Novair under a \$60.862 contract from NASA.

**Videotapes** Use *Gyro-El* or videotapes—a combination of visual and audio instructions—is growing in computer industries. Industrial Systems Division of Hughes Aircraft, whose videotapes originally were developed IAW Jan. 4, 1968, § 750, is now marketing a complete work station built around a television receiver (color and black and white). In addition, the Applied Communications Division of Loral Systems recently installed 70 audiovisual units for production-line guidance and training of new personnel at Loral's facility in Woodland Hills Calif. Applied Communications was set up early last year by a group including several who had worked on videotapes at Hughes, and others were recruited several months ago.

► **Tellurium-induced photocurrent detectors** work from single crystals of elemental tellurium and enable to liquid nitrogen temperature ( $77\text{ K}$ ) approach the proton noise limit of detectors in the  $1\text{ to }4\text{ aA}$  current region. J. S. Balmer of Minneapolis-Honeywell reported at a recent conference on electro-optical and solid-state devices. The tellurium detectors have their peak response at

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control



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This time control panel is adjustable over a 20°F range, holds temperatures to ±1% after a 10V-240 second, has built-in fail-safe features, meets specifications of MIL-E-8751A. Power requirement: 4 watts max. @ 125 V ac. Load: 3amps maximum @ 250 Vdc or 115 Vac.

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# NEXT STOP: MARE IMBRIUM



One of the primary goals in the next generation of our space program is for a reliable "space bus" to carry a variety of exploratory packages to the moon and possibly the near planets. Once it is injected onto a lunar or planetary trajectory, this bus will guide itself to its destination, accomplish a soft landing, activate and release its payload.

The problems involved in the design of such a vehicle, and of the many kinds of lunar and planetary exploration packages it might be called on to carry, are being intensively explored at Northrop. These investigations cover guidance, communications and position sensing systems, thermal and environmental conditioning, structural and material developments, system integration, trajectory and

avionics analysis, computer design, self-contained, extendable general support systems, and a host of other essential areas.

If you are interested in taking part in this effort, and have the experience, ability and creative insight to work well in advance of the state of the art, there may well be a place for you at Northrop.

All qualified applicants will receive consideration for employment without regard to race, creed, color, or cultural origin.

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## NEW AVIONIC PRODUCTS

■ **Microstrip array amplifiers**, for operation at temperatures up to 100°C., can achieve maximum Model 53100 occupies a volume of 0.56 cu. in., can deliver up to 50 watts at 40 volts rms. into



coaxial tapered waveguide. Nominal gain is 6,000 at 10,000 picots input repetition. Operation is from 28 vdc. Bulletin 1541 gives application data. Manufacturer: Svera Development Corp., 2 Willis Court, Hicksville, L.I., N.Y.



■ **Magnetic-clutch potentiometer**, consisting of a base, U-shaped clutch and spring center mechanism coupled to a center-tapped potentiometer. When clutch is engaged, potentiometer can be rotated in either direction; when de-energized, potentiometer shaft is retained in either 15 deg. or 30 deg. end-stop position or 90 deg. at fastest if needed. Clutch operates from 75 vdc. Manufacturer: Diate Instrument Corp., 131 Bates Way, Sycamore, I.L., N.Y.



■ **Lightweight switching wave tube**, Type 2-3005, for operation in the seven to 11 hertz frequency range, has noise figure less than 17 db, with maximum gain of 55 db and minimum power output of 5 milliwatts over the usable range. Focusing magnets are

temperature compensated over temperature range of -70 to 100°C. External assembly, including magnets weighs 2.6 lb. Dimensions: 9.4 x 2.2 x 2.6 in. Price \$2,810. Manufacturer: General Electric Co., Power Tube Dept., P.O. Box 620, Schenectady, N.Y.

■ **Porous ceramic material**, KE-14, for use in conductor insulating in electronic and aerospace equipment, is available in almost unlimited variety of shapes, including disks, cylinders, tubes, plates and blocks. Dielectric constant is extremely stable, manufacturer says, over temperature range from 35 to 300°C. Manufactured: Custerite, 900A East Rue Ave., Milwaukee, I.W. Wis.



■ **Cristat**, for rapid cooldown of infrared detectors to -100°F., is able to drop temperature from 72°F. to minus 70 in one second, or down to -100° in 1.2 seconds, according to manufacturer, using carbon dioxide. Other models, when charged with other fluids, can produce temperatures lower than minus 100°F. Cristats are available for various dot sizes, ranging from several seconds to several days. Walter Kidde, Aerospac Division, Bellmore, N.Y.



■ **Solid-state switch**, Type SW-100, switches on command at 100 picots per second and can handle repeat signals within a range of microseconds to milli-seconds with no latency. Solid-state switch requires no external transformer and requires no less than 25 milliwatts. Closed circuit resistance is less than 100 ohms. Device outputs less than 0.5 vdc and weighs 1.5 grams. Device has a built-in switch used to turn off a DUT at switch closure. Manufacturer: Alpha Tronics Corp., 1855 E. 46th Street, Torrance, Calif.

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- (2) Surface-type, for "point-contact" temperature sensing, the Well-type, for sensing point temperature. Cycle times from one second to 10 minutes. Meet MIL-E-5202A. Write for bulletin No. 446.







#### LIGHT-WEIGHT UNCOOLED ROCKET NOZZLE

This drawing is representative of advanced material systems application in high-performance solid rocket nozzles.

- 1 TUNGSTEN LINER resists 5000-6000°F flame temperatures and high shear flow stresses.
- 2 GRAPHITE INSULATION yields graphite insulation, prevents diffusion of oxygen, insulates and insulates gas pockets between liner and heat sink.
- 3 GRAPHITE HEAT SINK provides rapid absorption of heat from liner into graphite. Shape is a function of apperance requirements.

- 4 CERAMIC INSULATOR prevents a high-temperature thermal barrier to prevent heat transfer into plastic insulation.
- 5 PLASTIC INSULATION serves the dual purpose of preventing over heating of outer wall and adds rigidity to the system.
- 6 FLANGE AND SPINE ASSEMBLY of high-strength alloy provides structural integrity and allows nozzle to be assembled from the outer side.
- 7 OUTER SLEEVE of filament-wound plastic provides maximum efficiency at a strength density basis.

## MARQUARDT—The Qualified Source for Complete Rocket Nozzle Systems

Marquardt's continuing programs of research, development, and fabrication in the ultra-high temperature areas of refractory metals, metal reinforced ceramics, and other composite materials provide a single, complete source for complex rocket nozzle systems. This capability is fully documented by a proven record of materials engineering, processing, and production accomplishments.

Marquardt's unique ability to produce intricate components and systems for the aero-space and defense industries is substantiated by company sponsored research programs in manufacturing innovations. New levels of efficiency and economy in fabricating techniques are tangible results of these programs. Development studies are presently being conducted in high-energy forming of tungsten sheet into radical shapes impractical to form by standard processes; in improving techniques in welding pure tungsten sheet; in producing spin forged tungsten casings and forgings on a high-volume basis.

Significant materials and manufacturing achievements at Marquardt include the development and production of spin tungsten rocket nozzles; a wide variety of nozzle liners and parts; fixed and variable afterburner nozzles; complex attitude propulsion systems and controls; and ramjet nozzles.

Sixteen years of technological experience gained in research, development, and production of a broad range of power systems for atmospheric and space flight are important benefits offered by Marquardt engineers. This leadership combined with extensive facilities provides an exceptional capability for the development and production of reliable high-temperature materials and structures. Detailed information about Marquardt's advanced manufacturing capability may be obtained by writing Corporate Director-Marketing, The Marquardt Corporation, 16665 Baytree Street, Van Nuys, California.

Engineers and scientists experienced in these or related fields will find it rewarding to discuss career futures with Marquardt. All qualified applicants will receive consideration regardless of race, creed, color, or national origin.



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## AERONAUTICAL ENGINEERING



TECHNICIAN at Bristol Aero conducted a series of flutter tests on this model, which is shown on test rig in sheet photo.

## Heat Poses T.188 Structural Problems

By Herbert J. Cohen

LONDON—Use of stainless steel in construction of the British Type 188 Mach 2 research airplane—until because of a wide and varied temperature range in operating conditions—has posed design and construction problems for the British manufacturers.

Verstifitite has been built into the design since the T.188 will perform flight research at speeds in excess of 1,500 mph for periods long enough to make adiabatic heating and cooling rates limiting factors. Steel's thermal conductivity ratio to the rest of the shock absorber

material was given in the design to provide ratio to popular steels.

The T.188 uses an underground ground ramp rate of 10 ft per second. The engine is a de Havilland Gnome (series D.G.) 10 turboprop engine, which produces 10,000 lb thrust each. The engine is fitted with afterburner which operates at a combustion temperature of 2,000°F. (1,100°C) and produces a thrust increase of 40%, to 14,000 lb total thrust. The engine will make its first flight soon.

Because of our standards used for the wing and fuselage introduced design and development problems some of which have been outlined by D. I. Vulture. Bristol aircraft chief engineer. For instance, the wing is 10% thicker in thickness and is modified in cross section, than the problem of retaining a conventional leading gear was seen. To attain the design objective, Bristol devised a main gear strut which occupies the full depth of the wing. The rear portion of the strut is set at the end of the shock absorber.

To provide effective roll power at supersonic and subsonic speeds, with no crowding of control power, Bristol designed an all-moving stabilizer which eliminates all moving tips and trailing edge flaps. Vulture noted that the structural problems in these elements are considerable.

Allowing ample time to haul to the top of the fin and operate it in a power control within the air. At the rear of the fin is a plain, stub rudder.

A significant target for the T.188 de-

signers was reduction of the problems of fatigue, heating through development of materials used in the steel. This involved research undertaken by Bristol and Firth Vickers into materials with these properties:

- Highest possible elastic modulus;
- Highest possible strength consistent with reasonable ductility and freedom from strain-correlation;
- Minimum disparity between transverse and longitudinal properties;
- Maximum heat resistance to correct effects of adiabatic pressure;
- Strength and toughness of shear of high standard of fatigue and surface finish;
- Minimal possible drop in properties at the operational temperature.

Resultant tests produced two broad classes of steel from which the aircraft is constructed. They are:

- A 12% Cr (chromium) duplex ferritic material in the 140,000 psi at 15°C static tensile stress range;
- A stabilized austenitic 18/8 Cr/Ni

(Johnson-Matthey) steel at about 128,000 psi to 6.5.

Explaining this choice, Vickery noted that, for structural purposes, cutting light to 1.5 lb/in.  $\times$  in. was the most weight-saving study for vehicles that required a tensile strength of about 1200 (121,200) psi. Mach 3 corresponds to about 2500 (2560) kips. During performance assessment of materials, reference plastic strength and stiffness for the range of temperatures of various aluminum alloys, titanium alloys and steels.

Intergalactic choices, Vickery continued, just determine where you are "unacceptably weak" at around 1200 (121,200), while the degree of tensile strength of stainless steel was considered small. However, specific strength of pure boron and titanium alloys was better than the quoted steels. Altimetals also offers the reference a stress curve at about 1200C (1212F) so that for the same temperature the titanium steel was "death improved" to both aluminum and titanium alloys.

These were considered fruitful that development of stainless steel could lead to structures potentially suitable for higher temperatures, but these would be a long delay in delivery. However, a form of the 12% Cr steel was being used in heat-resistant applications in turbine engines, and the austenitic steels were in production for lower



CLOSEUP shows profile welding joints which employ two methods in high strength weight ratios.

strength application purposes. For commercial use, this also was being used in wide tolerance specifications, which prompted Boeing because of the steel's greater tensileability was double compared to aluminum.

Although the 12% Cr steel met the original strength requirements but had a great density, it obtained large toughness effects which were lost in the high heat-treated condition. Strength fluctuating was unacceptable. Later, an acceptable product was devised by "black tempering" and however, this was followed by annealing, tempering and aging, leading to close tolerances.

For the austenitic steel, the elastic modulus of 25  $\times$  10<sup>10</sup> was substantially lower than that of the 12% Cr steel

(31  $\times$  10<sup>10</sup>) but this was improved by a final heat treatment. At Park Victoria, technicians worked out protection by a continuous strip-coating process. Use of these strips provided similar thicknesses to dozens of bolts, doglegs and fasteners. Although the strength of 12% Cr steel worked out in test-pile condition of 149,000 psi could not be in square or rectangular tanks, these methods were incompatible with limited areas in many parts of the fuselage or on the tanks. Baked button rigs and jacket nests were developed to solve this problem.

A welding technique was developed to overcome the difficulties of mechanical fastening. Called "profile-welding," this method is achieved by local concentrated fusion of the sheets of wire sold beneath the arc automatically struck from an electrode within an argon gas shield.

This technique was used for jointing throughout the 1.155 diameter and one-piece sections, while the inner materials from 0.5 in. thick to 0.012 in. thick. Welds also can be made within structures as rare as 4 in. deep. Boeing uses the method in variable hot shells in regard to both design and production to avoid accumulation of minute shortcomings or distortions.

Other design problems arose because



SMALL JETTISON FUSELAGE was used extensively in fuselage construction.

of stresses induced by temperature gradients in the fuselage during the heating and cooling phases, even heating cycle results in one stress cycle. Thermal stresses also can affect ability of the 7.188 to meet its flight load. Vickery pointed out:

"In general, the temperature differences exist for greater times than the buildup of heat in a given mass, as the temperature goes from an average to free. Metal gradients will exist when the steady speed is reached, when 'x' could be pulled. In the locality of large heat sinks, the thermal stresses can exist for many minutes."

Vickery added that thermal stresses

are "likely to have more effect on ultimate strength when they are compressive than when they are tensile."

In the thermal investigation, the Boeing design team studied their future:

- Restraint on fuselage expansion produced by bulkheads, a condition existing because bulkheads do not heat as quickly as the outer shell. This can be solved in cost of fuel tank bulkhead kept cool by fuel nozzle. Most severe restraint is on fuselage expansion and is fuselage strength, restraint housing of struts and an adverse effect on the previous strength of the skin-stringer combination. To alleviate this, Boeing uses a light alloy above the bulkhead, restrain cool, stronger girders at the fuel tank ends have been made by a single pin to provide minimum axial bending stiffness along the shell.

- Spanwise restraint by span webs of wing and tailplane skin expansion, a problem minimized by keeping restraint of span webs as small as possible. Intermediate webs are connected vertically to the upper center and load stiffener. Because of the restraint here on longitudinal temperature differences, as does the absence of any large heat sinks, i.e., the presence of fuel.

• Temperature gradients exist in the fuselage due to large heat sinks generated by the fuel, and a complex



THIS MODEL was used to measure flutter on test section at low speeds.

pattern of shear and end loads is set up at the fuselage skin. Vickery said calculations can only give approximate information on the stresses which are involved.

- Transient materials used in rocket launcher are particularly sensitive to thermal stresses, these have to be some form of glass because of high temperatures. In addition, if "g" forces are applied at inclination to slow the off plane down, resulting aerodynamic loads can give tissue stresses, that is creating the compression. Boeing uses an air load balance, which is associated with low coefficient of expansion to reduce magnitude of thermal stresses to an acceptable point; use of solid fine glass was found to put unacceptable heats on E-184 performance.

Boeing has made extensive use of the fuselage contained fuel supply at a heat

## Secret base for Polaris subs: three-fourths of the world

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Space-Age Project "SUPER THRUST"

## A CHEMICAL EXPEDITION...

...exploring hydrocarbons for High-Mach fuels...  
seeking new paths to heat stability

Monsanto research is making significant strides forward in the search for heat-stable hydrocarbon fuels for the next generation of jet engines. Working under contract with the propulsion laboratory, Wright Air Development Division, Monsanto chemists are blocking out a variety of hydrocarbon compounds for fuels "tailored-to-fit" to gas dynamic requirements. These fuels promise to meet the three main pressing fuel requirements:

- High thermal stability
- High energy per unit of weight and volume
- Optimum heat transfer capability

To meet stringent fuel requirements as they become more closely defined for advanced jet engines, Monsanto has screened some 4,000 chemical compounds. More than fifty hydrocarbons have been selected for intensive evaluation based on their promising physical properties.

From the exhaustive search and continuing experiments, Monsanto research has determined that a hydrocarbon fuel in its presentable reach that would be most effective over the 500°-800° F. range, for high heat stability, will yield optimum service as the heat sink... essential in advanced design practice to relieve the lubricant, engine components, thrust chamber and "skin" from heat stresses.

### IMPROVED DUAL-PURPOSE FUEL - ENERGY AND HEAT SINK, HEAT STABLE, SUPER THRUST

From present study, it appears that the compound with optimum jet fuel properties may turn out to be either a relatively simple mixture of highly "pure" cyclohexane and benzene or a carefully selected mixture of refinery streams, hydrocracked to saturation and carefully separated. This concoction would be a

thermally stable fuel, not a run-of-the-mill mixture. As such, it would provide more clearly defined physical and chemical properties for predictable performance.

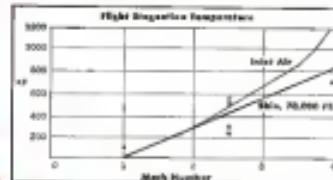
Its requirement parameters are becoming fairly clear: BTU's per pound—18,500 to 20,000; viscosity; specific gravity—0.85 to 0.90 (at 60°F); no cold-flow or "gumminess" to 500° F. In addition to heat stability, one question must be answered: have maximum heat availability (a weight-and-volume basis) to increase the jet thrust rating?

Monsanto is in an unusually sound position to help engine makers and the military in solving the fuel problem. Its Special Projects Laboratories are staffed and equipped for precisely this type of research. In addition, Monsanto's Organic Chemical Division has extensive experience in hydrocarbon synthesis. Through its Kline Oil Division, Monsanto has a basic research position in refinery products (and the research facilities) to study the possibilities in paraffins, naphthenes and other cuts of refinery streams.

Several candidate fuels have already been prepared and maintained in evaluation quantities (for example, isopropylbenzene). Study is continuing in many other areas, including both naphthenes and paraffins. In addition, a variety of "candidates" Monsanto needs to know specifications based on design the density limits, onset heat stresses, ignition thrust levels. With these parameters "pinned," Monsanto can guide the engine maker to a variety of candidate cyclic or paraffinic hydrocarbons for evaluation.

### ENDOTHERMIC REACTION FUELS— ANOTHER AVENUE TO "SUPER THRUST"

Chemically, there is little chance that a saturated hydrocarbon fuel stable above 200° F. will be found.



At all sonic speeds, engine heat can be dissipated by convection in the air. At speeds higher than Mach 1.0, the rate of air cooling reaches a maximum at high Mach speeds; air cooling is breaking. The frictional heat of endothermic strong and the latent heat of

Mach Number	Approximate cooling requirements:	
	MIN. THR. BTU/lb. of fuel Required	BTU/lb. of fuel Available (R-4)
1.0	★ 130	170
1.5	★ 220-250	270
2.0	★ 310	370

\* Concentrated liquid jet fuel heated from 100-400° F.

angular conduction must be disrupted to move heat off the vehicle so it does not overheat. If a fuel is endothermic, oxygen hydrocarbon fuel, no. 2, has a favorable ratio of heat pickup over ascent of Mach 2.5. Fuels having higher heats of heat pickup are required. (Please turn page.)

However, a fuel system may be developed—which exceeds capacity of undergoing endothermic reactions—that will operate in environments in the 1200-1200° F. temperature range. Besides, this requires the development of a composition to be converted to flight in the aerial tank, in a "package"—either as a solid or liquid fuel, which has both the latent heat of fuel burning and the friction heat of combustion during. Endothermic fuels show promise of increasing energy savings through greater fuel efficiency, since heat energy normally lost in combustion during the endothermic conversion and released during combustion. A few of the promising possibilities programmed for experimentation:

#### Thermal Cracking of Hydrocarbons:

Crosslinks:



Heat Absorbed: 370 BTU/lb.

#### DePolymerization to Olefins:

Dihydroxyethylene



Heat Absorbed: 360 BTU/lb.

#### RetroDiene Scission:

Measurements of dihydroperoxides



Heat Absorbed: 310 BTU/lb.

#### DeHydrogenation and Aromatization:

DeHydrogenation of 6-membered naphthalene to an aromatic:



Heat Absorbed: 600 BTU/lb.

#### Stabilized High-Temperature Free Radicals (Series Researched):



Total Heat Absorption (variable heat plus heat of reaction): 3300 BTU/lb.

Monsanto research has yielded over several years<sup>1</sup> of specific compositions, an interesting starting point for heat sinks due to power improvement itself.

### Chemical Fuels—Another Chemical Capability of Monsanto

Where design and fuel performance are interdependent, you are invited to advise Monsanto's capability on the economy of the fuel. Write or call: Monsanto Chemical Company, Department AV-6, C Building, St. Louis 66, Missouri.

#### Monsanto Space-Age Projects for Government and Industry

- High-Temperature Hydrazine Fluids
- Cobalt Dielectrics for Electronics Equipment
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- Improved Nitrogen Oils for Solid Propellants
- Fire-Resistant Strength Fibers
- Hydrocarbon Fuels for Jets and Missiles
- Fire-Resistant Hydrazine Fluids for Ground Support and Missile Launching Equipment
- Radiation Resistant Heat Transfer Fluids
- High-Temperature Lubricants and Additives
- Radiation-Resistant Reactor Coolant-Moderators
- Inertialistic Semiconductor Materials
- Pure Silicon for Transistor Rectifiers, Diodes
- Ultra-Fine Metal Oxides
- Materials for Vibration Damping
- Heat Resistant Resins for Laminating and Bonding
- Inorganic Polymers
- High-Energy Solid Propellants

You are invited to work with Monsanto on your materials needs in any of the above fields of technology.



and. For example, the fuel is pressurized before entering the tanks and then it is used to cool hydrazine and gaseous oil, electrical devices and our instrument compartment.

Temperature considerations are important in design of the fuel system, because it must have a large range of densities and work range of attributes under which it must function. Since welded tank body structure was unsatisfactory, on Bristol investigated schemes for non-metallic structures in conjunction with methods welding and joining. A number of joint trials were made under load and temperature loads, made "flow" through several flight cycles of heat and cold, pressure and fuel storage. T-155 design was well advanced before a full design was submitted working tolerance limits of different sections was shown to have passed.

#### Interchangeable Intakes

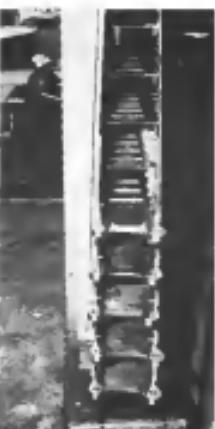
One of the major design aims of the T-155 was a requirement that engines be interchangeable, posing a problem of mounting the engines on the wing. Vitkin and a number of problems were considered, resulting possibly the engine to high off the ground and fitting the aircraft resulted in a mounted wing structure of low structural efficiency. Interchangeable intakes were sought.

In two-disk fuel tanks to place the engine in a centrally-mounted position in which the multiple wing span were considered thought to fit the supports or the structurally aggressive sides of a series of structural ring frames. Shell of the intake thus could be part of the torque mounting wing structure and vaporizing housing utilized if the ring frames could be utilized.

This construction problem—building a ring structural cylinder some 4 ft in diameter required to design a large cylindrical tank and fuel system which were enclosed not to provide integral ring frames with afterburner ports for bearing attachment of outer and inner wing panels. Shortly after, Vitkin tested folded ring rings of comparable size and this design is current as. Shell and frame walls are inclined to less than 6°. Thickness of the structural ring is given a weight per barrel of less than 250 lb. Current practice also is to have shell strength limited to 100 psi.

Bristol had difficulty in structural design of the intake intake, because high pressure developed forward of the intake and could not be prevented from leaking forward between the intake disk at the intake and the duct wall, on which Vitkin and others came up with pressure of "several atmospheres." Publie welding is used extensively to provide a tight structure strong enough to resist the loads

**CLOSUP** of T-155 missile head shows detail of inner rings which were developed by Felt-Vickox.



T-155 ring section is shown in ring at Mississippis plant. Note how high tensile strength and stiffness in place of biomass.

in design of the wing box, peak running load at the body side, a about 90,000 lbs./in. and several spars are used to stabilize compression side. Ring is provided in the middle barrel to keep the side walls from buckling under the weight of the wings.

These enter into problems in

the analysis of the barrel and are attacked to barrel rings by bolts which can shear. Ring size is also a critical factor and to keep the weight down, Vitkin decided to use an ultra high tensile steel (0.1% S) of 270,000 psi yield and 300,000 psi ultimate strength. Steel in this strength range had to be non-shimmed, so each spar and its associated

skin was bolted to a single flange, one of which was "grinned" the bags to attach to the single band.

Stainless steel of construction was used for both the outer and inner wing leading edge, and the outer skin was completely in the envelope of the outer box. The skin flaps are also plated and heat materials are in some strength range as the big flaps.

Tailplane which is subject to high cooling moments is caused flight tail peak and running load at the rest on the side of 16,000 lbs. in. Railing strength as much as a pair of panel loads at the hinge.

Vitkin noted that diffusion of these giant loads into a wide surface has been difficult, but many attempts have been made to hold the load in a broad area, including use of a pair of six rib attached from the hinge. Thus, the extended tail, either third of the triplane here, to minimize any shear lag effects, this made the mass action as much as possible efficient, so torsion to give normal stiffness. Maximum depth of the profile does not much exceed 5 in. or there could be risk in the case has between the nose and tip.

#### Airframe Structure

Airframe structure is two main load-bearing members, port and starboard, a box truss, wings, and the horizontal stabilizer sheet of lower strength and stiffness than the wing skins. Weight pounds less than, Bristol's was, is offset against benefits of the very solid shape.

The major failing of the fuselage design is the lack of a central longitudinal member, and the transverse sheet of lower strength and stiffness than the wing skins. Weight pounds less than, Bristol's was, is offset against benefits of the very solid shape.

Installation of the high-strength-priority flight control was difficult because of the weight in the wing box and fuselage. This factor and large flow requirements at high pressures led to development of a range of rigid pipe sections, including round and flexible, paper bonding gear and speed blaster also are hydrostatically stressed.

Heat insulation is reduced by getting heat to the fuel. However, since most portions of the hydrostatic system remain idle at cruise at low rates when the engine is hot, Bristol experienced some difficulty in finding a fuel with acceptable high temperature properties, while demanded thermal stability.

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**BENDIX** Type 335 linear actuators are constructed as a single actuator

and economy, range and high bulk modulus.

Proposers again were given latitude in selection of electrical system components, such as cables, buses, switches and plugs.

An conditioning system is an essential part of the augmentation system using engine bleed air as a source of supply. Cooled discharge air is the cooling medium for the primary cooler. The bleed air passing through the heat exchanger before going to the water-cooled heat exchanger is heated to meet the needs of the cold air used over the engine. Water-leak detection and removal at high altitudes when air mass flow through the system is at a minimum.

At passing through the cold air and era it will be at temperatures around 400°C (750°F) and this undergoes a cooling process under contract from the Avco Ordnance Group. The 14-ft bathocerous piston is solid propellant, will supply 153 watts of air and its power to maintain an acceptable temperature.

At the pilot's command, air is supplied directly from the cockpit or running air supply. In case of system failure, cold air supply is derived from a compressor or bottle for protection.

## FAA Plans \$12 Million Supersonic Studies

Washington—Federal Aviation Agency plans to run the \$12 million required to launch a supersonic transport program for studies by two major manufacturers and a study by three aerospace manufacturers if the companies agree to invest their own capital in the project.

Federal Aviation Agency Administrator N. E. Hickey told a House Agi-

mentation Subcommittee that as a result of these studies the U.S. could decide within 18 to 24 months whether and how to continue the project.

Spectracorp, Hobbs, will be the government contractor to put up most of the developmental costs, the estimate would agree to pay some more and the purchaser of the 200 aircraft—which might cost \$125 million—would agree to meet some basic development costs in the purchase price.

## PRODUCTION BRIEFING

Garrett Corp.'s Aerospace Mill, Los Angeles will develop a traction generator for one of the missile applications under contract from the Army Ordnance Corps. The 14-ft bathocerous piston is solid propellant, will supply 153 watts of air and its power to maintain an acceptable temperature.

Sperry Utah Co., Division of Sperry Rand Corp., Salt Lake City, Utah will continue production of Sergeant 600 kW static power under Army contracts totaling \$11.5 million. The solid propellant Sergeant is scheduled to replace the liquid fueled Corporal missile in a production role at the division.

Avco Corp.'s Licensing Division has signed an agreement with Paggio & C. Genes, covering the manufacture of Licensing T53 and T55 gas turbine engines in Europe.

Northrop Corp.'s NASA Division, Hawthorne, Calif. will conduct a TRIGA Mark II research reactor to study effects of space radiation environments. Reactor will be supplied by General Dynamics' General Atomic Division.

United Control Corp., Bellevue, Wash. will supply about 30-40,000 contact form boring, chemical mechanical equipment for controlling temperature of contact law to Micro-heat (ICBM) guidance and control systems while missile is in storage after assembly.

Nikon-Lockheed Memorial Co., El Segundo, aircraft armament enterprise with an authorized capital investment of \$12 million, will be engaged in the manufacture of Lockheed's signal suppression armament systems. New firm was formed by Lockheed and seven Japanese companies. First removal system will be installed at Norden, Japan, next year.

Nike Zeus interceptors, which began earlier last fall testing first May 25 at Armstrong Field, tracking an Atlas missile fired from Cape Canaveral while missile is in storage after assembly.

General Electric Missile and Space Vehicle Division has \$1.5-million Air Force contract for sensor and control equipment for Mariner and Mariner 4 near cones at nose Atlas ICBM bases. Work began last year under letter contract and is to extend through 1982.

Atlantic Research Corp. has a contract for \$2.4-million to produce 12 Test vehicles for use in NASA's upper atmosphere research program.



## North American Proposes Two V/STOL Concepts

Vertical liftoff and landing testbed based on the North American T231 Skystreak is proposed by North American Aviation Columbus Division to flight test General Electric's J85 340-hp VTOL concept (AW May 15, p. 26). It would have lift-off from a wing. Wing profile would feature zero landing gear. North American plans to build the following VTOL transport planes with six crew heads to gain flight experience. The tilt-wing transport would have a gross weight of 5,200 lb. and payload capacity of 1,000 lb. cargo or five passengers. Lippisch will be lead Allison T401 contractors (196 units) for speed range from 300 to 350 kt. Y-tail aircraft is another configuration to NASA's first test payload tilt-wing 60-unit VTOL transport program (AW May 1, p. 34).



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Specular Reflectance	200 to 30,000 Rayleighs
Collimation	<2° to >4°
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BREGUET 941 with flaps in STOL configuration deflects propeller blades downward, inducing lift.

## Breguet Developing STOL Transport

By Robert E. Farnell

Pans—First flight earlier this month of Breguet's 941 transport marks the confirmation of the French company's 11-year STOL effort based on the deflected deflection of blade wingspan principle.

The four-engine 941 (AWM Mar. 15 p. 20) powered by Turbomeca Turmo 111D free turbines delivering 1230 shp each will lift off at a gross weight of 17,000 lb. at its gross weight of 20 tons. The experimental aircraft is designed for military and civil service. A single prototype was financed by the French government with the understanding that follow-on production would begin by mid-1968.

Breguet is also planning a 50 per cent heavier version of its 941 STOL transport designated the 942. Prototype of this version is expected no later than 1969. Deliveries of the 942, presently priced at \$300,000, are scheduled to begin in 1970. No firm orders have been placed for either the 941 or 942. Breguet officials however are confident military and commercial interests surround both aircraft.

Breguet's STOL efforts began in 1948. An early prototype centered on the surface deflection principle, the high-b, developed a static stall deflected flaps deflected propeller blades downward, thus reducing lift. The aircraft flew 34.75 ft. as the propeller "blow" over the entire wing surface. Change over from deflected upstream lift to normal windward lift is progressive. Breguet says the aircraft is low lift.



BREGUET 941 is powered by four 1,230 shp Turbomeca Turmo turbine engines.



WING TRAILING EDGE features double flaps. The second flap acts only as a flap in its lowered position and as a flap and aileron in its deflected position.



## LIGHTWEIGHT FIGHTER WITH

Here is the Northrop N-156...a bold new concept in fighter weapon systems

The twin-jet supersonic Northrop N-156 is more than an aircraft; it is a complete family of lightweight fighter weapon systems designed to fulfill the many air support roles of limited war: close support of ground forces, reconnaissance and surveillance, interdiction, air defense and air superiority. The N-156 can be deployed from the United States zone of interior to any point in the world within 24 to 48 hours. It can then be dispersed throughout the theater of operations, utilize advance bases with short, unimproved runways, and operate with minimum

logistic support, fast turnaround and extremely low maintenance downtime.

Its high performance, extreme maneuverability and ease of handling have won the Northrop N-156 unanimous acclaim as a "pilot's airplane." An exceptionally safe and reliable aircraft with unequalled aerodynamic stability, it can accomplish its mission, return and land safely with one engine out. Very low fuel consumption eases the storage and resupply problems likely to plague advance areas. Maintenance and service can be easily accomplished from ground level without

## A HEAVYWEIGHT PUNCH

designed specifically for limited warfare...ready now.

crew stands. In short, from both a tactical and logistic point of view, the N-156 is ideally suited to the mission requirements and problems of limited warfare.

The economics of the Northrop N-156 are also highly favorable for limited warfare. Low initial cost plus exceptionally low operating and maintenance costs make it possible to greatly increase the number of units in the field for the same budget dollar. Simplicity of maintenance also reduces the number of trained personnel, the amount and complexity of ground support equipment needed in

the field. The result is an extremely flexible force, able to respond effectively to pressures anywhere in the world in the shortest possible time, and with minimum dependence on the difficult supply posture likely to prevail in remote areas.

The Northrop N-156 has been flying since July 1959. It is a developed weapon system, ready for immediate production. Deliveries can commence in just 14 months.

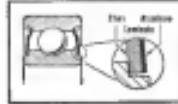
**NORTHROP**  
NORTHROP CORPORATION, BURBANK, CALIFORNIA

# TO KEEP YOUR BRAINCHILD SPANKING CLEAN

A spaceman's helmet can keep a boy's face clean for a while, but the protection is far from permanent. A new Barden development, however—Flexoil—positively seals precision bearings against dirt while retaining needed lubricant, thus greatly increasing the reliability of high-speed motors, generators, computer memory drums and other equipment.



Bestowed with a Flexoil precision bearing, this spaceman's helmet seals tight against a grubby surface of dirt and dust to effectively seal out dirt and retain bearing lubricant.



**BARDEN is a major producer of precision ball bearings for instruments, weapons systems, computers and other high quality equipment for reliability... specify**

**BARDEN**



**PRECISION BALL BEARINGS**

THE BARDEN CORPORATION 201 Park Ave., Detroit, Mich. Phone 5-9501  
Western Office: 2800 Wilshire Blvd., Los Angeles 5, Calif. Phone 5-5004



## SEALED PRECISION BEARINGS

Barden uses Flexoil where the demand for a low-friction seal that can stand up at high speeds in contaminated environments. Flexoil bearings are precision bearings with a seal of fluorocarbon elastomer that fits smoothly against a ground surface on the outer ring. The design effectively seals in lubricant, seals out contamination and prevents airflow through the bearing. Friction is negligible and the bearing may be run up to the life limit imposed by the lubricant.

## TEST RESULTS

Barden Flexoil bearings have been operated up to 3,000 hours at 60,000 rpm in variable gradiants. Flexoil stands up under load speeds of 5,000 feet per minute, as against 2,000 to 3,000 fpm limits of most other rubbing seals. Operating temperatures range up to 300°F.

## AVAILABLE NOW

Barden bearings are now available in ten unflanged and four flanged sizes from 3/16" to 1-3/8" O.D. For further data, ask for Flexoil Data Sheet F-1.

spool subassembly must be driven to the propeller shaft, thus permitting the 941's high payload due to its low weight.

Some safety factors of Breguet's STOL aircraft are provided by the aircraft in which the aircraft's low gross weight is much more than its maximum structural weight. If a propeller fails in flight, it is disengaged by the motor and the aircraft's remaining propulsors are used to the limit engines.

Correspondingly, failure of one engine does not mean failure of all propellers. The three remaining engines continue to attain symmetrical operation of the four propellers. Breguet cautions, however, that failure of one engine means a loss of thrust of only 25 percent with a drag in excess of some 33% of conventional five-engine power ratings.

Safety factors were also designed into the flexion system since future long-wind criteria STOL performance. Thus, minimum lip extension is provided by means of a mechanical linkage composed of a torsion shaft which allows extension or non-extension both. Flaps are operated simultaneously. If one or two dependent hydraulic circuits, either one being capable of operating the flap mechanism.

Breguet engineers feel the aircraft's lateral control is less, perhaps too little, unassisted snap-up wing. The angle was also linked to the differential longitudinal control system. It is planned the company will develop one of these Breguet designs for the U.S. market.

The first prototype of the 941, as it was then, was hampered by tailplane fluttering under STOL conditions at high speeds. Then, stall tendency was reduced by reducing the tailplane's incidence and by fitting the leading edge with an inverted camber fin.

Most of these various flight control fin-and-sailor-like devices disappeared in the final configuration, which was thoroughly tested in Breguet's own STOL flying testbed, the 940. This aircraft, growing some 15,000 lb. in first flight in May 1978, flew over the past year with the 941 has flown about 1,500 hr. At an average weight of 10,000 lb., the 940 shows a 1.1 D/L ratio, which is excellent for a STOL aircraft within 675 ft.

The only difference between the 941 and 942 is the latter's smaller fuselage designed for a different payload of about 3.5-tp. Wings of both aircraft consist basically of a box beam made of two with spans and one inboard spar. Wing covering is fluorocarbon elastomer material. The wings contain four integral fuel tanks with total capacity of 1,940 gal. The leading edge contains a retractable slot. The trailing edge houses double slats. The second flap can extend in a flag in its inboard section, as well as a dogleg and drooping in its outboard section. Conventional servo controls are provided on the elevators, rudder and ailerons.

Mass may consist of new, modern aircraft designed to the strict shock absorber. Shock absorbers also use air

## Breguet 941-942

901 902

Span	76.1 ft.	76.1 ft.
Length	76.3 ft.	76.3 ft.
Height	18.7 ft.	18.7 ft.
Wing area	800 sq. ft.	815 sq. ft.
Fuselage weight	23,175 lb.	23,995 lb.
Max payload	19,460 lb.	19,660 lb.
Max takeoff weight	41,600 lb.	41,600 lb.
Min landing weight	36,600 lb.	36,600 lb.
Max payload	14,830 lb.	12,100 lb.
Color length	5.9 ft.	30.1 ft.
Cabin length	7.4 ft.	6.4 ft.
Cabin width	8.0 ft.	9.6 ft.
Cargo hold volume	1,300 cu. ft.	850 cu. ft.

Payload: 400 kg. Takeoff: 7,000 kg.  
TUD for turbines of 1,250 hp each  
four-bladed Breguet propulsors of  
1475 hp. da.

Landing gear track 13.8 ft. 13.5 ft.  
• Pure cargo version

Breguet engineers feel the aircraft's lateral control is less, perhaps too little, unassisted snap-up wing. The angle was also linked to the differential longitudinal control system. It is planned the company will develop one of these Breguet designs for the U.S. market.

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gaps which prevent significant loss of the aircraft's ground attendance. The main gear is a two-wheel unit with fairings on each side of the fuselage. The strake has a main wheel and gear retraction motor for the engine fairing.

Breguet's 942 passenger STOL aircraft has a four-blade cabin arrangement. This permits high density passenger configuration (117 seats for five seats) or a mixed passenger/cargo mix. The latter configuration is seated in right rear of the cabin plus a cargo held in front of the cabin or in the passenger compartment. The 942 has a maximum cruise altitude of 15,000 ft. on the 941's take-off weight.

Cruise of the 942 is broken down in the following manner: cruise, \$16,000; passengers, \$92,000; cabin config cost, \$10,000; luggage, \$17,200; transportation system, \$10,000; total cost, \$88,000. Using the normal ATA method, dollar cost per flight hour would not be \$17,500 for the 941. This is based on 55 passenger loads and annual utilization of 3,000 hr.

Breguet officials feel that STOL aircraft specifically, the 941 is needed if a market largely unmet is up to now. This market, they claim, holds down • Short-haul air service where road and rail doesn't exist and import facilities are primitive, gain strip after. Many prove the best example of this market.

• Short-haul air service is developed in areas where air service is needed but is restricted due to insufficient landing facilities

## CAB Requesting Bids On Cargo Cost Study

Washington—Civil Aeronautics Board is soliciting bids for a complete study on air cargo costs designed to help the CAB in formulating air cargo pricing guidelines.

An agency has a great need for information on air cargo expansion for cargo forwarders in the future. CAB Chairman Alan S. Boyd told perspective bidders, "We need a broad base of these consciousness fast to adapt the right policies."

Noting that the volume of potential air cargo is sensitive to rates, Boyd said a comprehensive analysis of cargo costs to be completed by Nov. 1, would aid CAB in making decisions on those costs.

• Basic relationship between costs and rates  
• Treatment of promotional rates  
• Methods of introducing new rates  
• Effect of new flight frequencies on rates  
• Profitable rates needed for volume segments.



**TRANSATLANTIC** record-breaking USAF B-52 lands down at Le Bourget Airport, Paris, France, at the 24th International Air Show. The aircraft completed the flight from New York City in 8 hr. 29 min. 41 sec.

## B-58 Record-Breaking Crew Members Hailed at



AFTER returning commendations from USAF Com Leo W Johnson about their excellent performance in N.E. Frontline, general com. and pilot flight, Captain Dr. G. C. Gossman, USAF Col. J. K. Johnson, USAF, 4th Bomb Wing, Command USAF Tax, and J. T. Coyle, USAF project manager, General Dynamics RTW, wrote a short, CIO letter noting that Maj. Fred. Capt. Polkman and Capt. Wagner are among the Charles A. Lindbergh plaque of Recipients.



**MAJOR WILLIAM R. PAYNE**, Tidwell (B-52), pilot on the second bombing flight of May 26, gets the word upon his arrival. Other members of the crew were Capt William L. Follmann, Waite N.H. and Capt Raymond E. Wagner, Houston, Tex.

Paris Air Show



**TOASTING** the success of their record breaking season, members of the era's top golfers—Walter Hagen, Alister MacKenzie, Sam Snead, Gene Littler, Art Wall, and A. S. Werlef (A. S. pro golf manager, General Draughtsman), with Sam Leishman, Johnnie Wilson, and Tom Price.

**CREW OF B-52** is shown below in its aircraft. The plane targets for an instant bombing flight of 30 over 45 sec. A closed circuit 100-050 camera is used to record each mission at 1000 frames per sec. Lt. David R. Dickson, defensive systems operator; Anthony Gila, shown at right of Mafusian Blanca, Major Flores H. Mierloper pilot, Fairview, Ind., and Major Ernest F. Moles, navigator. Alonso Pu. graced in front of the bombers along with C. S. McFarlin, Ground Defense (A) and N. E. Farisian, C-47 Flight Propulsion Eng. (B). This is the same man who was killed when the B-52 crashed about 6 sec later.



AVIATION WEEK, June 13, 1963

SPACE...IMAGINATION...ENERGY



## HERE'S HOW WE MEASURE MISSILE MUSCLE



This is one of the test-bays at the Hercules-owned-and-operated plant at Belvoir, Utah. Here the third-stage engine for the Minuteman rocket was developed and is manufactured for the Air Force. The advanced second-stage Polaris engine, developed for the Navy at Allianty Belvoir laboratory, is also being manufactured here. Belvoir Research plant is a fully integrated facility for research, development, and production for manufacture of high specific impulse solid-fueled rocket engines.

As each new design idea is proved out in running flow, a set of custom-gated transducers take the engine's pulse, its temperatures, check its pressure, stresses and strains. This set of information is fed, at 20,000 bits



per second over 240 separate input channels, to a central data acquisition room where it is permanently recorded on synchronous magnetic tapes. Meanwhile, as many as twelve high-speed cameras exposing up to 3,000 frames a second on a quartz-coated film, keep a visual record of everything that happens with thousandths-of-a-second accuracy.

Thus, each test of component, propulsion unit, experimental design or completed engine yields a maximum amount of information ready for computer analysis and extraction to advance both design systems and manufacturing methodology. This is just another example of Hercules imagination in propulsive engineering.



Chemical  
Propulsion  
Division

**MERCERLES POWDER COMPANY**

Beloit, Kansas  
Wilmington, North Carolina

БИОМУ ТОЧК АЛЬТ ЭЛДЭЭ.

This is one of a series of abstracts from dealing with the facts about adoption. Though much of the information is elementary, no library will be of much use in using this material as it would be of little value to anyone.



## Tests for Determining Mechanical Properties of Alloy Steels

The types of tests used to evaluate the mechanical properties of an alloy steel depend upon the end use of the steel involved. Mechanical properties are determined usually by tension, bend, and hardness tests, and by a group of special tests employed on tubular and wire products.

(1) Tension tests provide means of determining tensile strength, yield point, yield strength, proof stress, proportional limit, per cent elongation, and per cent reduction of area. This sort of test subjects the steel to stresses resulting from the application of an axial tensile load to the specimen ends, the load being sufficient to restrain the specimen.

(2) Bend tests often aid in determining the ductility of steel. The severity of such a test depends largely upon the bending radius used. Several factors influence the length of radius, including thickness of the test specimen, width of test specimen, direction of test, chemical composition, tensile strength of specimen, etc.

(3) Hardness tests determine the metal's resistance to penetration. This characteristic is most commonly measured by the Brinell Test or the Rockwell Test. In the former, pressure is applied to the surface of a test specimen by means of a ball 10 mm in diameter. Two diameters of the resulting impression are measured and averaged; the average is converted to the hardness number by means of a conversion table. In the Rockwell Test, the degree of

hardness is read on a gage; hardness is measured by the penetration of a diamond point or a 1/16-in steel ball. Rockwell "C" scale readings are used in connection with the diamond point; "B" scale in connection with the steel ball. The "C" and "B" are the most commonly used of the several Rockwell scales.

(4) Special additional tests are often made on tubing and wire products. These include such items as hydrostatic and manipulating tests, and torsion and wrapping tests, the latter two being used only with wire.

The subject of testing and its relationships to the end uses of alloy steels has been given broad study by Bethlehem metallurgists. If you desire, they will be glad to discuss any phase of it with you, and also give unbiased opinions on such matters as analysis, proper selection of steels, machinability, etc. Call for their services at any time.

And when you need alloy steels, remember that Bethlehem furnishes the entire range of AISI standard analyses, as well as special analyses, steel and all carbon grades.

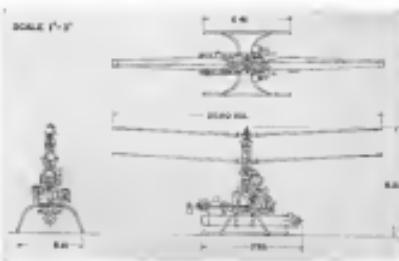
*This series of *After the Advertisements* is now available as a compact booklet, "Quick Facts about Aftery Stacks." If you would like a free copy, please address your request to Periodicals Department, Bethlehem Steel Company, Bethlehem, Pa.*



## Gyrodyne Drone Passes Operational Sea Trials

Launch, return and posture of the Grombow DSN-1 DASH (Space and atmosphere integrated) weapons system were proven during operational test and evaluation trials conducted at the USAF Hanscom (303B) of Elmira, Fla. Sea trials conducted in March by the Navy's Operational Test and Evaluation Program ensured the prime contractor, DSN-1, had met all performance requirements of Grombow's three-phase DSN-1, new solid propellant, Elm-DASH, powered by a Boeing 7000-RD-4-270 motor, will be conducted during the first year of flight testing and evaluation. Test flights will occur at the Naval Air Warfare Center Test Pilot School, Patuxent River, Md., and the Naval Air Warfare Center Training Systems Division, Orlando, Fla., to demonstrate the launching and posture of a submarine combat system. The three off site locations and comprising a radiometric guidance system, suited to provide data along its trajectory. The DSN-1 team (JRW May 29)

29) is a bio-Medical coated bioprosthetic powered by a 72hp. Formula standard automotive engine. Roto-axial, dual-shaft contact an is incorporated on the 72-blade. Improved power-to-weight ratio of the turbine-powered DSN-3 should enable the device to carry a much greater payload than preceding efforts at no more than 1000g. The DSN-3 will be able to fly a single flight. Dimensions compatible with the NASA's Pegasus (B-747) mothership for launching from the ground. PRA-432 (Beta model) is the manufacturer of the DSN-3. The cost of the destroyer's reply, a longer flight duration, and DSN-3 dual plus spares and the device's solid titanium Gibbs which would permit the bioprosthetic, make possible life as he wished it to the destroyer's cockpit deck. X-ray, West Coast did not need much assistance.



## PRECISION GUIDANCE



### POLARIS "ON COURSE"—TIME AFTER TIME AFTER TIME

Over 40 Polaris missiles—with completely operating inertial guidance systems designed by Massachusetts Institute of Technology and produced by General Electric—have been flight tested from land, at sea, and under the sea.

The reportedly precise, reliable performance of this MK-1 Inertial Guidance system now in being applied to the advanced MK-2 Polaris Inertial Guidance system by M.I.T., G.E. and Raytheon.

This new, advanced guidance system will be much lighter and more compact and will help lengthen the working power of Polaris from 1000 to 2500 miles.

Polaris Inertial Guidance is typical of the exact precision products—antennas, fire control, inertial guidance, launching and handling equipment, torpedoes—being produced by General Electric's Ordnance Department.

### ORDNANCE DEPARTMENT an IEL DIVISION ELECTRONIC DIVISION

**GENERAL ELECTRIC**

14 PLAZA, NEW YORK, NEW YORK 10036

RESEARCH, DESIGN, AND PRODUCTION OF PRECISION ORDNANCE EQUIPMENT—SINCE 1941

## FINANCIAL

### Aerospace Industry Profits—1958-1960

Aerospace companies in 1960 enjoyed more than twice as great a profit as in 1958, but a compilation of financial reports for the last three years in the accompanying table indicates varying industry attitudes.

Market analysts say the performance of individual companies has been the rule. There is a glimmer of aid or lack of same off in congressional defense transport programs. American companies on the other hand, generally denote how changing technology has affected profits and sales.

The averages tabulated on each a fraction of those which in part are involved in aerospace business is which comes in as an increasingly important ingredient. Examples are listed to show a representative cross section of various segments of the industry.

Figures compiled at the Securities and Exchange Commission's and the Commodity Futures Trading Commission's Quarterly Report show profits for the aerospace industry of \$13.47 billion in 1960, an increase of \$3.287 billion. Profit margins, however, in the industry averaged 4.25% and on net worth 7.37%.

Figures in the accompanying table indicate \$13.5 billion as a conservative estimate for the size of the aerospace market. Using only military data of companies such as General Electric and Minneapolis-Honeywell, the total figures for the last alone is near \$17 billion.

The First National City Bank of New York, in its tabulation, estimated industry profits of \$13.8 million in 1960 compared with \$10.5 million the year before. The 1960 figures represent a

profit margin on sales of 1.2% compared with the year before and 6.5% on net worth compared with 9.9% in 1959.

In manufacturing, which normally accounts for over half of corporate net earnings, almost two out of three firms reported gains in sales but only one in 20 had higher earnings. The overall disclosed profit squeeze shows up most emphatically in the performance of defense in earnings per dollar of sales and invested capital, reflecting rising cost pressures under competitive market conditions that territorialize corresponding price advances.

	SALES (in billions)			EXPENSES (in billions)			PROFITS AS A PERCENT OF SALES			BALANCE SHEET (in billions)			PROFIT MARGIN ON NET WORTH		
	1960	1959	1958	1960	1959	1958	1960	1959	1958	1960	1959	1958	1960	1959	1958
<b>AEROSPACE VEHICLES</b>															
Bell	\$1,010	\$1,008	\$1,021	\$144	\$142	\$141	14%	14%	14%	\$1,010	\$1,008	\$1,021	14%	14%	14%
Boeing	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Cessna	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Convair	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Grumman	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Hawker Siddeley	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Lockheed	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
McDonnell	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
North American	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Northrop	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Philco	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Pratt & Whitney	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Rockwell	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Sperry	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
United Aircraft	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
United Electronics	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Vertol	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Wright	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Yerkes	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
<b>Automobiles</b>															
American	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Chrysler	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Ford	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Plymouth	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Studebaker	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Volvo	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
<b>Automotive Systems</b>															
Delco	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Delco-Remy	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Motors	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Hoover	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Motorcraft	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Nash	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Studebaker	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Volvo	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
<b>Electronics</b>															
AT&T	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Electric	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
ITT	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Motorola	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Philco	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Raytheon	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Sperry	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Teletype	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
<b>Industrial</b>															
Alcoa	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Dynamics	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Mills	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Telephone	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Motors	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Petroleum	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Precision	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Steel	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Tire & Rubber	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General Zinc	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Goodrich	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Imperial Chemical Industries	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
International Harvester	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Kodak	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Lever Brothers	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Merck	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Montgomery Ward	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Procter & Gamble	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Standard Oil	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
<b>Propulsion</b>															
Aviation	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Automotive	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Chemical	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Electrical	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Food	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
General	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Household	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Industrial	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Leather	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Plastics	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Textile	1,000	992	981	140	139	138	14%	14%	14%	1,000	992	981	14%	14%	14%
Wood															

## Ling-Temco and Chance Vought Work Out Details of Merger

Dallas, Tex.—Chance Vought Corp will be reconstituted as a subsidiary of Ling-Temco-Vought, Inc., if an audit and preparation are held by Ling-Temco Electronics, Inc.

An overall plan, approved by management of both enterprises, provides for exchange of shares of stock for shareholders and investors, other than the shares held by Ling-Temco Electronics, Inc. Each share of Vought stock would be exchanged for \$43.30, principal amount at a new 5% convertible debenture plus a coupon amount to have one-eighth of a share of Ling-Temco Vought, Inc., stock at \$33 per share.

The debentures would be convertible into common stock at 141V<sub>2</sub> per share, plus a fixed amount of cash for each debenture, for a period of five years, one year, and one half years thereafter. There are about 1,250,000 shares of Chance Vought stock, outstanding with approximately 35% held by Ling-Temco Electronics, its officers and directors.

If the proposal is approved by the holders of at least 66 2/3% of Vought common stock, the offering closing date is Aug. 11. The alternative date of at least a majority of the outstanding common stock, and 41% of the convertible stock, will be avoided for adoption of the exchange by a majority of stockholders of Ling-Temco, racking up the close of the company's name.

Possessing extensive and wider shareholder coverage, to be held June 30, have been mailed to stockholders of both companies.

Consuming the federal tax status of the exchange, Chance Vought's counsel has the opinion that the exchange by each stockholder of the company of his ownership in Ling-Temco stocks and warrants will be taxable transaction, non-ascertainable gain or loss will be realized for federal income tax purposes upon such exchange by each holder of Vought common in the extent of the difference between the fair market value of the Ling-Temco debentures and warrants received and his cost or other applicable basis in the Vought common which are rendered in exchange. A ruling has been requested from the Internal Revenue Service in the event that any gains or losses realized by any holder of Vought common will be capital gains or loss, provided that no capital gains tax is payable on the basis of the holding.

The debentures will be in full registration form without coupons in the accumulation of \$330,000, \$33,000 and my multiple of \$3,000. They will bear interest at the rate of 5 1/2% per year,

payable semi-annually and will be convertible at three principal anniversaries into common stock, at Ling-Temco Vought price up to 141V<sub>2</sub> per share, plus a coupon, date Sept. 1, 1973, at \$34.50 per share if convertible as of or prior to Aug. 31, 1966, and thereafter at a conversion price of \$33.54.

Ling-Temco Vought officers will be Robert McCallum board chairman and chief executive officer, James J. Long, chairman of the executive committee; Gilbert K. Johnson, president; Claude Sines, executive vice president; Raymond C. Blacklock, vice president technical director; Lee D. Webster, vice president research and technical; and James J. Kerley, executive controller.

The chairman of the new company will consist of McCallum, Long, Sines, Blacklock, W. F. Thayer, Wickes, D. D. Reed or D. H. Reed Enterprises, Dr. V. A. Deshpande, Dr. Lewis Castle of Rice University, Robert B. Gifford of Dr. Gifford & MacNaughton, T. J. MacNaughton of Herman Appleby & Co., William H. Odham, Jr. of Luhman Brothers, Tom W. Post of American Life Insurance Co., L. T. Peter of Lone Star Gas Co., James D. Wilcox of Continental Electronics Manufacturing Co. and W. C. Wadsworth of Wadsworth Properties. Each of the directors will be entitled to a number of options to purchase stock in Ling-Temco and one-half firm.

The new company would employ a total of more than 20,000 persons and a combined balance sheet would show total assets of \$109,446,118 as of Dec. 31, 1968. Combined earnings for 1968 were \$162,112,245 and net earnings were \$11,873,279. Total backlog at year end was \$300 million. Ling-Temco Vought, Inc., earnings for 1968 will include earnings of Chance Vought units for Aug. 31-Dec. 31, 1968 period.

**Collins to Skip Dividend Because of Low Earnings**

Coleen Radio Co., Cedar Rapids, Iowa, will not give a dividend for the second fiscal year, noting that although earnings for the 12 months ending July 31, 1968, were expected to be at least 20% higher than the current \$100 million of 1968, earnings for the current fiscal year will not be significantly greater than the \$2.6 million earned in the first six months.

A unusually large increase in product development expenses and increased migration of government business to the principal account given for the decline in earnings for the second half



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TIGHT TOLERANCE,  
THIN WALL,  
PREMIUM CASTINGS  
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OR 1,000's**

The picture shows some exotic Alcoa premium castings. We call them unusual because such is a sophisticated example of high strength, intricate configurations, dimensional accuracy, smooth finish—of four parts. Take the working of the extreme right. It's a complex casting. The two cores are independent of one another. Gating is at 496. Wells are #380. Tolerances are on the interior passages. It's #380. Surface finish is 16 mils.

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### ENGINEERS and SCIENTISTS

SATIN is an example of MITRE's program effort in large control systems. Detailed applications are currently available in three programs for full-time engineers, mathematicians and physicists with active computing needs. If you have an interest in computers, common sense, control systems or aircraft and like to get new ideas to work, there may be a place for you at MITRE's expanding Air Traffic Control activities. Openings are also available at MITRE's facility in Montgomery, Alabama.

Inquiries may be directed to:

VICE PRESIDENT—TECHNICAL DEPARTMENT  
P.O. Box 388, Waltham, Massachusetts

A job announcement fully describes SATIN and its activities is available upon request.

All qualified applicants will receive confidential treatment without regard to race, creed, color or national origin.



### 2150-A Specifications

Engine	Loring O-320-A2B
Wt. and spn	319 @ 2,700
Gross weight—Normal category	1,587 lbs
Utility category	1,570 lbs
Empty weight	1,121 lbs
Useful load	682 lbs
Wing span	39 ft
Wing area	144 sq. ft.
Length	21.2 ft.
Height	7.8 ft.
Propeller diameter (in.)	74
Fuselage length (in.)	12.12
Wing loading (lb./sq. ft.)	12.5
Fuel capacity	35 gal.
Maximum speed	145 mph
Minimum cruise	135 mph
Stall speed	52 mph
Takes off distance (30 ft. altitude)	40 ft.
Landing distance (30 ft. altitude)	50 ft.
Best rate of climb (gnd)	75 mph
Sea level rate of climb	5,493 fpm
Fuel consumption	
75% rated power	10 gal.
65% rated power	8.1 gal.
60% rated power	6.2 gal.
Crusing weight (std. m)	325



Shrike 2150-A is 18.2 ft. high at 7 ft., and wing area is 144 sq. ft.

craft are quite straightforward and no special techniques is required to effect safe, smooth landing. The approach with flaps down is made at 80 mph, which drops down to 60 mph when landing approach (PAL). Although the aircraft can land at 50 mph, the landing gear would be broken at 70 mph and a lot of power added.

The flap handle, located on the front cockpit, is beneath the pilot's left leg. When pulled up to extend the flaps, it causes some rotation of movement. The amount of rotation is in the angle of 10 degrees. Mr. Morrissey and the use of the flap handle has been changed to the production model to eliminate that interference.

The Shrike can be landed in a variety of ways. It can still be "spidered" or on the rear wheel. The best landing is with full flaps at 50 mph and the nose wheel is sufficiently high off the ground to start landing seems more gentle. No roll-over shock occurs when the nose wheel touches as in the case with some aircraft having the rudder mechanism linked to the nose gear for ground steering.

Visibility from the front seat is good and, even from the rear seat, the aircraft can make be operated both in flight and on the ground. Although there is no instrument panel in the rear, the rear seat pilot can observe the aircraft and atmosphere in the front cockpit. All necessary controls, stick, rudder, brakes, carburetor heat, throttle, with the exception of the flap handle, are duplicated in the rear seat.

Final rolling of the first Shrike 2150-A was preceded by an investment

of \$270,000 in tooling and production facilities including a hand built production, G. L. Shrike, president of the firm, says that first year production is to start and the facilities already being acquired to appear unique. Shrike says that without increasing plant capacity a second shift would be put in to take advantage for the company's backlog and another plant site probably in a developing employment area to supplement present space in Santa Ana.

Shrike has developed Class A tooling for production and according to Vice President R. L. Jaffett, 15 planes will constitute the full well force on the list. All index-hinged parts and landing gear are subcontracted, leaving assembly and component installations to be done in the firm. After passing inspection, the aircraft will be shipped to the Santa Ana Ordnance, Canada, Airport for final assembly, check-out and production flight testing. More than 1,000 production tools have been developed for the aircraft and at low cost, high rate production.

### Marketing Operations

Shrike's marketing operation will follow along with the present day trend of aircraft distribution through dealerships. Shrike will be controlled by a limited base, thereby eliminating the therefore far working usually plagued at 50%. Shrike has a lot of dealers who already established an aircraft sales but who do not have a competitive line. The firm is now in the process of establishing new relationships which will largely be eliminated.

The Shrike 2150-A will come factory equipped with many extras available on other aircraft as optional features. In-

cluded among these will be an electrical system with starters, generators, navigation and cockpit lights, propeller rpm meter, sensitive altimeter, recording tachometer and a soundproofed attitude



### Bank Indicator

Flight equipment intended to facilitate the aircraft pilot's job consists of attitude and bank indicator mounted on a clock face dial and a reticle having attitude gyro (hodometer). Equipment is manufactured by Coven, Inc., 1338 Walnut Street, Wichita, Kansas.





THERE IS SOMETHING NEW UNDER THE SUN

Try, there is something new under the sun. Science is proving this every day. With new discoveries. New explorers. New concepts.

Nowhere is this more evident than in the field of technology. For example, On the driving boards of Lockheed Scientists and Engineers, new designs are constantly being developed in Spacecraft and Aircraft that will reinforce and enlarge our growing knowledge of Outer Space.

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**Scholars and Engineers** To learn more about the opportunities at Lockheed, write Mr. E. W. De Launay, Manager, Professional Placement Staff, Dept. 1105, 2406 N. Hollywood Way, Burbank, California. All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin. U.S. citizenship required. Equal Opportunity Employer. Defense industrial security clearance required.

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as there Allens or Boeing turbines  
Passenger are carried in a detachable  
pod which can be substituted for a cargo  
configuration as a military short-haul

The basic B-12 helicopter is suitable for both cargo and passenger operations and is specifically designed to picking the standard airline pod. Control stability and stability of the aircraft are

maintained by placing the cargo pod directly behind the cabin in the external bay without the aircraft's center of gravity. In addition to eliminating roll-off flight deck, the carriage position was the

The aircraft's configuration makes it especially suitable for carrying unusual cargo such as boats. Landing gear

The releasing of cargo can be made

accomplished with either the detachable pod load within the ascent's configuration or with the cargo carried in its operations as a flying cargo. In emergency situations, all loads, with the exception of the passenger pod, can be jettisoned at once by use of explosive bolts.

Complete failure of one engine in flight requires no extra piloting technique if operation after cut-off is observed with the good engine by depressing the pitch and increasing the throttle settings.

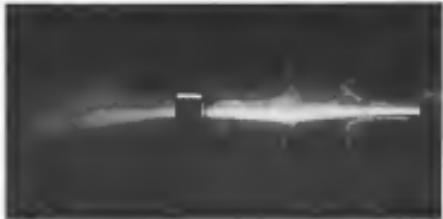
Production schedules at D&I models call for 25 assault in the first inventory—producing one batch per month for the first nine months starting June 1 with production schedule increasing as parts and equipment become available.

Portable Com/Nov

Airline recognition and communications system for business aircraft includes a 90-degree VHF transceiver, 90-channel VHF or other data selector and multiplexer. Price of the unit manufactured by Beech Aircraft Corp., Wichita, Kans., is \$2,091 for a 14-volt system and \$2,595 for the 28-volt unit.

# PHYSICISTS

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first orbital has been assisted by our unusual oscillating stationary ion engine which produces a high stability, electronically neutral plasma beam. Since this electronically-neutral plasma eliminates the space-charge effect, there is no theoretical limit in the thrust capability of this device.<sup>1</sup> In other areas of plasma research, new regimes a material expansion in this device<sup>2</sup> and in other areas of plasma research now require a material expansion in this article<sup>3</sup>. As a result, many other electronic Science Professors are being recruited for electrical propulsion specialists — particularly physicists with advanced degrees of experience.<sup>4</sup> These positions should have particular appeal to those interested in studies of high energy plasma sources, diagnostic techniques and other basic investigations that will lead to practical space propulsion devices. Recent work has been theoretical and experimental investigations of factors that determine plasma properties, ionization and power efficiencies.<sup>5</sup> This program is of the long range available-type with both corporate and government sponsorship. Superior facilities and resources are available for numerical computation and experimental work. Publication of papers is encouraged as is close contact with related university research.<sup>6</sup> Salary levels, benefits and the non-institutional approach will appeal to experienced men with demonstrated abilities.

You are invited to contact Mr. W. D. Welsh, Personnel Department.

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**STRUCTURES Analysis Specialist and Designer**—Minimum 10 years in missile and space-craft structures analysis work. Self-starting and capable of analyzing load paths and stresses by all materials used in space craft and missiles, defining a structural test program and guiding structural diagnosis.

**Aeroelasticity Specialist**—Minimum 10 years in aircraft and spacecraft aeroelasticity and dynamic aeroservoactuation, trajectory formulation, computer applications and analytical aerodynamic evaluation design, aeroelastic fluid dynamics flight performance analysis, stability and control, wind tunnel design and testing.

**Thermal Management Specialists**—**Staff Engineers and Engineers**—Minimum 10 years in thermodynamics field (missile and space craft). Analytical and design knowledge of thermal control techniques, convective, conduction, latent heat transfer, dielectric, insulation, corrosion, heat transfer in electronic packages, heat transfer through insulating and hyper-sonic structures, reionizing and deionizing effects, and thermal chemistry.

Send your résumé stating your areas of interest, or request for further information to Mr. Clyde W. Henson, Technical Director, Aerothermal Division, 2693 Ridgeway Road, Minneapolis 30, Minnesota. All qualified applicants considered regardless of race, creed, color, or national origin.

To explore professional opportunities in other Honeywell operations, come to coast, and your application is a welcome to Mr. R. B. Estes, Minneapolis, Minnesota.

## WHO'S WHERE

(Continued from page 25)

### Changes

**L. J. Stasko**, assistant to the general manager, Lockheed's Models and Space Division, Van Nuys Calif.

**Gerald E. Hughes**, head of applications engineering, Midland-Milwaukee Components Division, a Long Beach Electronics Inc. division, Calif.

**Capt. Thomas W. Brown** (USN ret.) named manager Army's Central Corp.'s Atlanta Division, Piedmont, Ga.

**George P. Karsik**, manager Solid Propulsion Operations, McCrory, Inc., of Rockford, a division of North American Aviation.

**Allen T. Laramore**, manager Advanced Materials communications program, Walham Laboratories of Subspace Electronic Systems, Williamsburg.

**Dr. Loydell T. Boatwright, Jr.**, director of engineering, Atlanta Southwest, Inc., Atlanta, Ga. 30339.

**Richard L. Jon**, electrical engineer in space components, Marconi & Space Systems Department of Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn.

**Robert J. Gillan**, general manager, Military Products Division, Rockwell, Chatsworth, California Electronics Rochester, N.Y.

**Thomas L. Paganini**, manager of the newly established System Operations Center, General Electric Co.'s Aerospace and Defense Electronics Division, Syracuse, N.Y.

**George H. Van Hoosen**, safety engineer, test, Avco's Guided Missile Range Division, Cape Canaveral, Fla., and D. G. Davis, test engineer, management reference no. 10000, Avco's Guidance and Control Division, Worcester, Mass.

**John V. Thorne**, manager Avco's propellant plant office (Patrick AFB, Fla.) for Flight Test Operations-Space Technology Laboratory.

**J. E. Lohr**, director manager Sperry Maintenance Electronics Co., Chatsworth, Fla., a division of Sperry Rand Corp.

**Mark S. Johnson**, director Space Division, Santa Clara, Calif., has assumed the responsibilities of the following product manager: S. W. Burns—Future Missile Systems; D. J. Geddes—Satellite Systems; Joseph R. Bousquet—Electronics, Communications Engineering Department, Aircraft Electronics Inc., Cockeysville Md.

**Melvin H. Brown**, sales manager, Test Systems Instrumentation Corp., Acton, Mass.

**James San Vicente**, chief engineer, plant design, Instrumentation Services Corp., El Segundo, Calif.

**Dr. Scott A. Johnson**, laboratory supervisor, Space Division, North American Aviation's Space and Information Systems Division, Downey, Calif.

**John C. O'Donnell**, director, Systems Research Laboratories, Lockheed Corporation of America, Bellwood, Ill.

**Dr. Daniel C. Schuster**, director of reliability, corporate reliability staff of The Martin Co., Baltimore, Md.

**Harold A. Chastain**, associate technical director, Space and Information Systems Division, Inc., Seattle, N.E. 98103.

**Mike Levy**, manager of polymer integration, Gulton Industries, Inc., Metuchen, N.J.

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## LETTERS

### Glossy Proposals

The clearest alternative to the Hinsdale Test Center will remain the one proposed by the Office of Defense Procurement (AVN, May 29, p 17) until we get substantial and long-term financial assistance from Congress.

But so long as glossy proposals act the part, glimmering proposals will be made. The facilities themselves will remain as they are now, and the public will continue to have its doubts about the cost and cockpit problems of what power the funding presents that there is what is needed to make them real.

The government procurement agencies and users in the aerospace parts contractor who do the major procurement for the government have been asked to review their requirements for proposals submitted to them to an extent that the essential technical, price, and delivery information is derived by a reasonable number of subcontractors doing this procurement and propose changes of all kinds. This would be a logical step in order to reduce the bidding and long lead time before the bid gets the sales. So far, he does not make too much money, which everybody in the industry knows is a much greater concern than bidding and long lead times.

The procurement and economy of the Wright leather seats avoided by experienced people at high places. Why can't it be done again? I believe that it can be done and perhaps being done already. The aircraft industry is in a very strong position of strength.

The answer to why it doesn't happen more often is complex and could be traced to the anticipated and expectations caused by our government. For the modest point which this letter adds to the discussion, the fact is that the members of the Wright leather did not receive program options and the spirit of St. Louis was built without St. Louis - or less room, thus it takes time to evaluate the proposal before a major selection of a new supplier.

The answer to why it can't be done is that the government procurement agencies could not cause to be done at the major aerospace prime contractors. Technical proposals can be requested to be limited to new "Price and delivery" as stated essentially in the same terms as it is done in the Wright proposal. A need to do this should be explained by the letters to express information learned that the government always, subcontractors specification with this multiple sources and addenda should be reviewed in documents that are issued to the contractors. Let there be a contract that says "anyone who can come up with the least in due respect."

Above all, build up confidence among the sellers that there is a sound technical proposal, a low price and the basic characteristics to sustain it will get the award. Even though the proposal is not proposed and the plant is located on the other side of the track.

H. W. Klemm  
Vice President-Chair, Engineers  
Consolidated Controls Corp.  
Bethel, Conn.

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### Test Pilots

In the April 17 issue of *Aviation Week* (p. 31) in an article entitled "Institutes Fly Test Pilots," it was mentioned that the Society of Experimental Test Pilots plans to use its members to conduct research and test the use of seat belts in aircraft due to recent increased pilot interest. The statement is even true.

No single individual within the Society has the knowledge and experience in the constitution of the health problems which would arise from wearing an airplane seat belt in such a seat. In addition the Society membership is composed of approximately 300 aviators, not pilots and engineers, and the test pilot committee of the Society would not take upon itself such responsibility. This does not mean the Society accepts this plan but has not as yet come up on the subject of worn seat belts.

A. S. Wurts

The Society of Experimental Test Pilots  
Long Beach, Calif.

### Elastic Prices

I see in the May 1 issue of *Aviation Week* in the article "Pain and Fingers" about Air Transportation that the increase in fares and modest gains which the letter writer asks for should be the result of the fact that the Wright leather did not receive program options and the spirit of St. Louis was built without St. Louis - or less room, thus it takes time to evaluate the proposal before a major selection of a new supplier.

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Fred Tomes  
Rutherford, N.J.

### Space Fantasy

As Aviator Adams' letter of May 21 reveals (AVN, May 29, p. 21) seems a bit odd. Why not cover the part of the car with a plastic coating and get all the advantages of insulation and protection? In short, as in my 1954 *Automobile Prospects* W. H. Davis could be brought in on the project and then we could do something with fuel and temperature. I am sure the people of orthopedic foods would be more or less willing to work with Adkins, and in short this would talk a Chicago like of Rutherford.

WILLIAM WEATHERS  
Fairfield, Conn.

### Space for Peace

In James B. Watten's status which was published in the Jan. 23 issue of *Warren Wall* (p. 79) were quite an answer. From his remarks I would gather there is a growing interest in space research and development, and that the United States would not take upon itself such responsibility. His ideas relate to many similar detailed explanations and study of the situation.

This all brings me to the point of my letter. It seems to me that we are moving on of the best approach we can have in our efforts to bring about world peace. Events on the outside may determine our only route to bring to much situations are our differences in the world.

One of the oldest tools to get someone moved off a course point is to divert him to another. In some ways children must be led and taught. I would like to think a child wants to do something dangerous or injurious to himself; you don't focus his attention on it but rather run along up some other issue interesting to divert his attention from the original problem until

When I try to do it a child's principle is that we are more interested in a freedom in a democracy than an Adlai E. Stevenson said. And someone who I would think has the ability to present special aspects of the situation is the Pope. He is a man who is going to own where we go there as who are blaring up where before we would in most words of the same title.

Through the U.N. are the United States ought to be leading the way in helping a tolerable amount of space at the disposal of all the group along with countries to be used as the potential conquering of space. We would then as other nations to follow suit.

If this could be done, I'd be willing to wager that we would soon be soft-pushing universities, atomic bombs and H-Bombs potentially.

At this late hour anything is worth a try, but we have to try.

John L. Jackson, Inc.

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